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OCTOBER—1944

No. 130

ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

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R. J. Painter, Associate Editor

Number 130 | October 1944

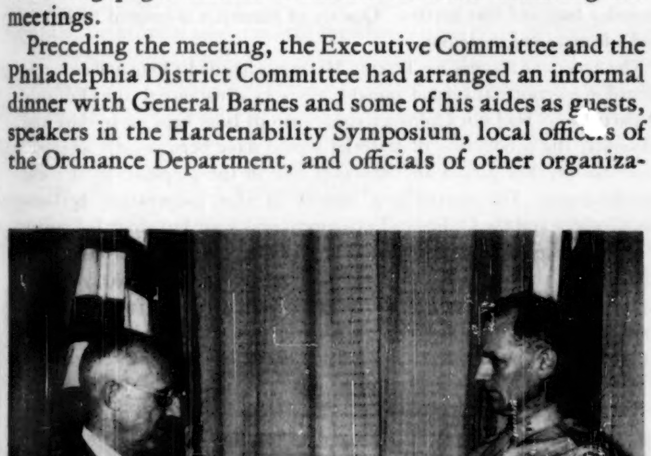
Society Receives Ordnance Distinguished Service Award

Diploma Presented to President Bates by General Barnes on October 12

AT A SPECIAL meeting of the Society on October 12 Major General G. M. Barnes presented to the Society's President P. H. Bates the Army Ordnance Distinguished Service Award. The ceremonies at the Franklin Institute on October 12 were short but impressive. Present, in addition to officers of the Society who were attending the Executive Committee meetings on October 12 and 13, were many members and former officers from near-by areas, numerous members of the Ordnance and other Army and Navy branches, and many local members and friends of the Society. A large number were concerned with the Symposium on Hardenability Bands which followed the special A.S.T.M. meeting. Pictures on the following pages include a number of those attending the meetings.

Preceding the meeting, the Executive Committee and the Philadelphia District Committee had arranged an informal dinner with General Barnes and some of his aides as guests, speakers in the Hardenability Symposium, local officers of the Ordnance Department, and officials of other organizations including the Franklin Institute and the American Standards Association.

The entire Society Staff was also present at the dinner and meeting, the opportunity being taken to procure photographs of the group which will appear in a future issue of the BULLETIN.



President Bates Receiving the Award from Major General Barnes.

MEETING TO RECEIVE AWARD

In opening the special meeting in the Franklin Institute Lecture Hall, President Bates expressed pleasure at the excellent attendance and the presence of so many who had contributed to the Society's work; then he introduced the Society's Secretary-Treasurer, C. L. Warwick, who presented Major General Barnes. Mr. Warwick mentioned briefly some interesting facts about General Barnes' activities prior to his appointment as Chief of Research and Development Service, the Ordnance Department, and he also referred to the presence of other representatives of the

Ordnance
Distinguished Service Award
presented to
American Society for Testing Materials
In recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of Ordnance materiel.
Award Authorized 20 July 1944

The accompanying photographs show the Head Table at the dinner preceding the Ordnance Award. In addition to Society officers, Ordnance officers, and others, Philadelphia District officers and speakers in the technical sessions (Messrs. Field, Boegehold and Boyd) are shown:

Judson F. Vogdes, Jr., Vice-Chairman, Philadelphia District Committee; Joseph Field, Bethlehem Steel Co. (only forehead shows); Dr. H. B. Allen, Secretary, Franklin Institute; Major Henry W. Gadsden, Executive Officer, Philadelphia Ordnance Dist.; A. L. Boegehold, General Motors Corp.; Col. J. B. Rose, Commandant, Frankford Arsenal; Secretary-Treasurer C. L. Warwick; Col. S. B. Ritchie. John R. Townsend, Vice-President, A.S.T.M.; Maj. Gen. G. M. Barnes; P. H. Bates, President, A.S.T.M.

Ordnance Department including Colonels C. A. Ritchie and John H. Frye who have been in close touch with many phases of A.S.T.M. work.

Since General Barnes' short presentation address is published in full below all that need be said in this news account can be covered by the statement, "a gracious and appropriate message."

Much the same situation exists with the remarks by President P. H. Bates in receiving the diploma. His short address also is published here and each member of the Society is urged to read it. He stressed the fact that he was receiving the award for the entire membership which had worked faithfully and effectively during the present emergency.

A photograph of the diploma showing the citation appears on page 5.

Presentation of the
Ordnance Distinguished Service Award
by
Major General G. M. Barnes

It is my privilege to present to the American Society for Testing Materials the Ordnance Distinguished Service Award. This award is given for the outstanding contribution which you have made toward the development, manufacture, and maintenance of Ordnance matériel, which has made possible the victories now being won by our armies on the battlefields of the world. I bring you the warm appreciation of the Chief of Ordnance—Major General L. H. Campbell, Jr.—together with those of the entire Army, for the work which you have done.

It is most essential that materials entering into Ordnance weapons and ammunition have the greatest uniformity and reliability, even more so than required for normal commercial purposes. A gun may be hauled cross-country at high speeds for days or weeks before it arrives at a point at which it is to be used firing at the enemy. At that time the gun must function 100 per cent and there is no time for repairs or adjustments. In the case of ammunition, millions of rounds of a caliber such as a high explosive shell must be made under mass production methods, loaded with a high explosive and equipped with a very complicated and sensitive fuse. This ammunition, like the gun, must be transported great distances, across seas, through jungles, to the gun position, sometimes requiring as many as twenty handlings before arriving at the firing point. When the round of ammunition is fired, that shell must function perfectly. It is subjected to very high set-back stresses within the gun, requiring strength and uniformity of the steel and the safety features of the fuse must insure that the shell does not explode until the target is reached. Ninety-nine per cent functioning for such ammunition is not enough, for if one high explosive shell detonates in the gun, not only will the gun be destroyed, but the crew will be killed. The requirements for reliability for Ordnance matériel are very high, and must be kept high, to save the lives of our own troops and to destroy the enemy. The failure of Ordnance matériel in service is not one of dollars and cents; rather, it is measured in terms of casualty lists and lost battles. Quality of materials is insured by proper and adequate specifications.

The American Society for Testing Materials has had a long and enviable record in its cooperation and valuable advisory assistance to the Ordnance Department. Had not Ordnance specifications been kept up to date and adequate, the production of matériel would have been greatly affected. Your Society has played an important role in the preparation of these specifications. The outstanding feature of this cooperation between your Society and the Ordnance Department was your broadminded policy of inviting representatives of the Ordnance Department to serve on your committees, thus welding the two organizations into an effective team. Today, there are Ordnance Department representatives on twenty-nine of your main committees and a great many of your subcommittees. There are some thirty Ordnance officers and engineers, including representatives of the Office of the Chief of Ordnance in Detroit and of four of our arsenals serving on these committees.

The Ordnance Department has greatly benefited also from your many committees upon which the Ordnance does not have direct representation. The preparation of specifications and standardization of test procedures in any material is of value to us, since the Ordnance Department uses practically all types of materials in the fabrication of its vast number of fighting weapons.

Here, tonight, we have a typical example of this close cooperation, in this meeting sponsored by the Philadelphia District on the "Hardenability Bands for Steel."

Your committee that developed the Hardness Conversion Table for Cartridge Brass has contributed greatly to the standardizing of hardness

Lawford H. Fry, The Locomotive Inst.; J. T. MacKenzie, American Cast Iron Pipe Co.; E. J. Albert, Thwing-Albert Instrument Co.

A. O. Schaefer, The Midvale Co.; F. G. Tatnall, Baldwin Locomotive Works; Francis B. Foley, The Midvale Co.; Rupen Eksergian, E. G. Budd Mfg. Co.

L. E. Ekholm, Chairman, Philadelphia District Committee; C. Jared Ingersoll, Chief, Philadelphia Ordnance District; Arthur W. Carpenter, Vice-President, A.S.T.M.; C. S. Redding, President, Franklin Institute; Col. W. K. Gerhardt, In Charge, Artillery Development, Army Ordnance; E. K. Spring, Chairman of Evening Technical Meeting, Henry Disston and Sons, Inc.; Col. John H. Frye; H. B. Bryans, President, American Standards Association; Luther C. Boyd, Carnegie-Illinois Steel Corp.; R. W. Orr, Secretary, Philadelphia District Committee.

values and conversions, not only within this country, but also within those of our Allies.

The Committee that wrote the Specifications for Pearlitic Malleable Iron Castings was of outstanding help in the preparation of the Ordnance specification for this type of castings. It is my understanding that this is the first commercial application for pearlitic malleable iron and results from the advice and assistance of your committee.

A short time ago the measurement of color in United States Army specifications for motor fuel presented a vital and difficult problem. This problem was placed with your Committee on Petroleum Products and Lubricants and in a short time a standard method of test for color was developed and is now being used in Army specifications for fuels for all theaters of war.

The Committee on Plastics has contributed greatly to the preparation of plastic specifications, and I particularly want to mention their work on nonrigid plastics.

The Committee on Specifications for Cellular Rubber Products was organized under the auspices of the Ordnance Department and handled specification requirements for sponge rubber, foam rubber, and similar types of rubber products.

The Department also requested the Society to form several Ordnance Advisory Committees and those on Paints and Varnishes, and on Petroleum Products and Lubricants have been of noteworthy assistance. There have been many other committees formed at the direct request of the Ordnance Department. It would be impossible for me in the time available to make an adequate review of all the work which has been accomplished by your organization in this, the greatest of all wars.

Your organization has also contributed to the war effort by supplying numerous personnel to assist on vital and urgent problems. The Society made a direct contribution by relinquishing its Secretary-Treasurer, C. L. Warwick, to the War Production Board to coordinate civilian and Government specifications. This work has been of material assistance to industry and to the Government.

In making this award, the Ordnance Department acknowledges with appreciation the cooperation and assistance which the American Society for Testing Materials has given, not only during the war, but also during the many preceding years of peace. At no time could our organizations have cooperated in a more direct and fruitful manner than during the past twenty years or more. It is hoped that this citation will also serve as a constant reminder of the need for a continuation of this splendid cooperation during the coming peace years.

I want to read the citation:

Philadelphia, Pa.
Oct. 12, 1944

Presented to American Society for Testing Materials in recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of Ordnance matériel.

Mr. Bates, it is a great honor for me to have the privilege of presenting to the American Society for Testing Materials the Ordnance Distinguished Service Award.

Acceptance of the
Ordnance Distinguished Service Award
by
President P. H. Bates

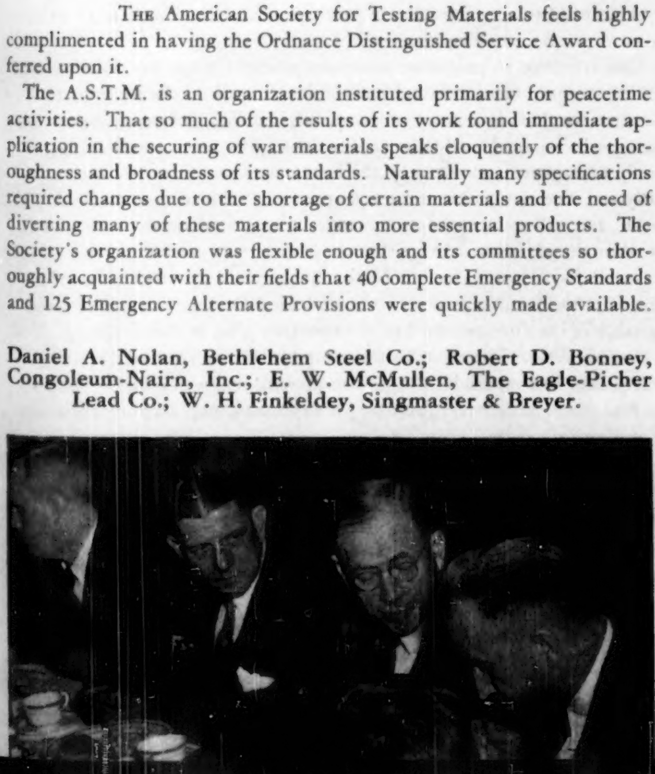
The American Society for Testing Materials feels highly complimented in having the Ordnance Distinguished Service Award conferred upon it.

The A.S.T.M. is an organization instituted primarily for peacetime activities. That so much of the results of its work found immediate application in the securing of war materials speaks eloquently of the thoroughness and broadness of its standards. Naturally many specifications required changes due to the shortage of certain materials and the need of diverting many of these materials into more essential products. The Society's organization was flexible enough and its committees so thoroughly acquainted with their fields that 40 complete Emergency Standards and 125 Emergency Alternate Provisions were quickly made available. These have been found by the military agencies to be consistently satisfactory.

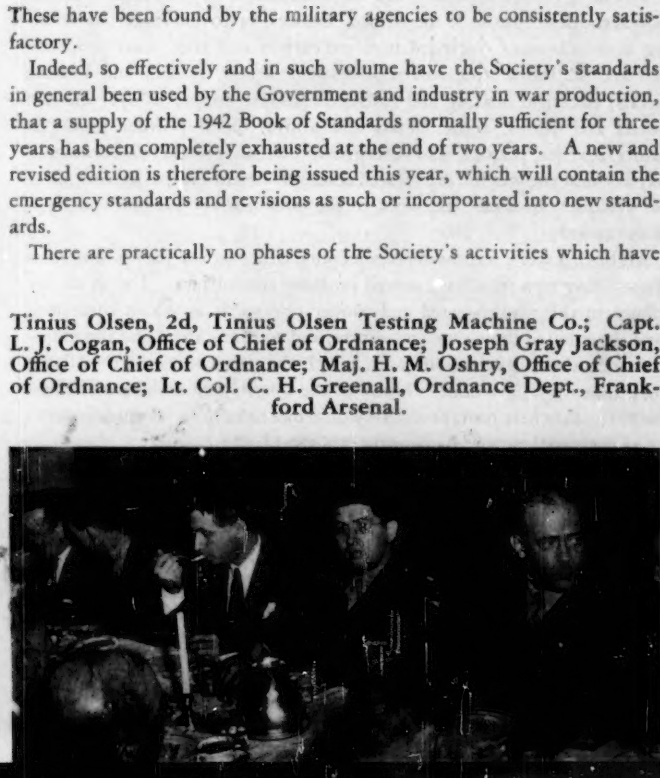
Indeed, so effectively and in such volume have the Society's standards in general been used by the Government and industry in war production, that a supply of the 1942 Book of Standards normally sufficient for three years has been completely exhausted at the end of two years. A new and revised edition is therefore being issued this year, which will contain the emergency standards and revisions as such or incorporated into new standards.

There are practically no phases of the Society's activities which have

Daniel A. Nolan, Bethlehem Steel Co.; Robert D. Bonney, Congoleum-Nairn, Inc.; E. W. McMullen, The Eagle-Picher Lead Co.; W. H. Finkeldey, Singmaster & Breyer.



Tinius Olsen, 2d, Tinius Olsen Testing Machine Co.; Capt. L. J. Cogan, Office of Chief of Ordnance; Joseph Gray Jackson, Office of Chief of Ordnance; Maj. H. M. Oshry, Office of Chief of Ordnance; Lt. Col. C. H. Greenall, Ordnance Dept., Frankford Arsenal.



Col. S. B. Ritchie

Col. J. H. Frye

Major General G. M. Barnes

A graduate of the University of Michigan in Civil Engineering in 1910, he entered the Army and was successively in the Coast Artillery Corps, on duty in the Ordnance Department at Watertown, and on other assignments. During World War I in the Office of Chief of Ordnance he was responsible for the design and development of railway and seacoast guns, and later was on duty in France. After service as ordnance officer in Germany he was in charge of design and development of antiaircraft artillery and for four years through 1932 was Chief Engineer at Watertown Arsenal in charge of research and development. Later he was Chief Proof Officer, Automotive Division, at Aberdeen.

Successive responsibilities in the Office of Chief of Ordnance have been Chief of the Technical Staff, Assistant Chief of Industrial Service (July, 1940) and when the Technical Division (formerly the research and engineering section) was made a main division of the Ordnance Department he became its Chief on July 1, 1942. His duties have involved tours in Europe and North Africa. He was made a Major General in March, 1943. In February, 1944, he was awarded the honorary degree of Doctor of Engineering by Illinois Institute of Technology.

Colonel Scott B. Ritchie

Following graduation from the U. S. Military Academy in 1917, he served in the Coast Artillery Corps until 1921 at which time he entered the Ordnance Department. He was overseas in World War I with the Artillery. A graduate of several Army schools, he was awarded in 1931 by M.I.T. the B.S. Degree in Mechanical Engineering. He was on duty at Watertown Arsenal and at Aberdeen, and then from 1925 to 1931 at Watertown again where he was concerned with important work in ordnance involving centrifugal castings, high-speed tool steel, armor plate, etc. Following a period on Ordnance Field Service, he was for five years beginning in 1934 concerned with procurement planning and industrial mobilization, and in 1939 went back to Watertown in charge of the laboratories and later as Production Manager. Since July, 1942, he has been Chief of the Research and Materials Division and Assistant Chief of the Research and Development Service in the Office of the Chief for Ordnance, Washington.

Colonel John H. Frye

A graduate of Ohio State University, he was, prior to entering the Army on October 9, 1940, Metallurgical Engineer for Columbia Steel and Shafting Co. and its affiliates. He has served as Metallurgical Adviser to General Barnes, and has assisted in the metallurgical phases of the development and production of Ordnance matériel. He organized the Materials Branch to carry out work on new materials and processes, and to supervise specifications, and he has been responsible for conservation work in the Ordnance Department. He has been greatly concerned, among other problems, with mass production of components, such as die castings, powder metals and products, and other items. A colonel since February 26 of this year, he is Assistant Chief of the Research and Materials Division.

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not been concerned with and positively directed toward assisting in the war effort. In fact, with the advent of war the Society adopted the policy of making available all of its facilities to assist the Government and industry in dealing with problems within the Society's field of engineering materials. In the announcement of this special meeting certain activities undertaken at the request of the Ordnance Department are specifically mentioned, and still others have been referred to by General Barnes. These included cartridge brass, fire-refined copper for wrought products, hardness conversion tables for brass and steel, aluminum casting alloys, method of test for color of Army fuel, and specifications for certain rubber products particularly with respect to the applications of synthetic rubber. Other work has been tied in with Federal specification activities or those of the Armed Services, or covers materials entering into ordnance. Included here are carbon and alloy steel products, cast and malleable iron, corrosion-resisting steels, solders and bearing metals, electrical heating and resistance alloys, copper alloys, die-cast metals and alloys, light metals and alloys, metal powder products, paints, textiles, plastics, and detergents. Without further elaboration, I may say that the war has stimulated accomplishment on the part of all of our groups. In short, the work of the *entire* Society has been the basis of the award.

All of this work has meant considerable effort on the part of hundreds of very busy men who have served on these committees. I wish to pay tribute to the wholehearted and cooperative spirit in which these men have contributed their time and efforts, and to thank them and the industrial and other organizations with which they are connected for all the work that they have done. Many of the officers and members of these committees are here tonight and all would like to be here. I am only serving as their spokesman in accepting this award.

General Barnes has referred to the contribution made by the Society in relinquishing its Secretary-Treasurer to the War Production Board to assist in war procurement and conservation work. It has been a matter of gratification to the Executive Committee, and I am sure to the Society as a whole, that the Headquarters Staff had been so well developed that in spite of the increased demands upon it due to the greatly enlarged technical activities and publications, it was possible to make Mr. Warwick's nearly full-time services available to the Government for this work. I sincerely trust that the members of the Staff too will look upon this award as a recognition of their services.

The suggestion of General Barnes that our cooperative activities be continued in the coming peacetime strikes a very responsive chord. We welcome most cordially the participation of the Ordnance Department in the work of so many of our committees. Such participation greatly facilitates the service that A.S.T.M. can render to the Ordnance Department and we look forward to continued active participation of the Department in the work of the Society after the war.

This reference to peacetime activities prompts me to say that we are giving the most careful thought to the future work of the Society, mindful that we shall face many economic adjustments and many important changes in materials and their applications. For some months a Special Study Committee appointed by the Executive Committee has been critically and objectively examining and appraising all phases of the Society's work, and will recommend such changes in organization and activities as are thought advisable in order that the Society may most effectively serve its members, industry, and the Nation in the years to come. The service that the Society can render to the Ordnance Department and to other agencies of the Government has an important place in this planning.

General Barnes: The entire membership of the Society, which before the war period and especially during the present emergency has worked so faithfully and effectively, joins me in expressing our deep appreciation of this award.

Philadelphia, Pa.
October 12, 1944

Fifteen New Standards, Numerous Revisions, Approved in August

Standards Committee Acts on Many Recommendations from Technical Groups

At its all-day meeting on August 28, the Society's Committee E-10 on Standards, which has the authority in the interval between Annual Meetings to act on the approval of new tentative standards and revisions, and also on proposed revisions of formal standards, reviewed a large number of recommendations from the standing technical committees, many of these having been developed at the Annual Meeting and confirmed subsequently by letter ballot. As a result of this full day's work 15 new tentative standards were approved and there were more than 25 revisions in tentative standards and proposed changes in standards. A detailed list of the actions appears later in this article.

One reason for so many actions by the standing committees, of course, is the publication in 1944 of the complete Book of Standards, a full year ahead of normal publication. Many of the committees were anxious to have their specifications as up to date as possible and also in some cases concentrated work enabled groups to complete proposed new standards, studies on which had been under way for some time.

Personnel:

At the meeting of Committee E-10, Past-President H. S. Vassar, Laboratory Engineer, Public Service Electric and Gas Co., was reelected chairman of this important group. Serving with him as members of Committee E-10 are Messrs. R. D. Bonney, Assistant Manager of Manufacturing, Congoleum-Nairn, Inc.; F. H. Jackson, Principal Engineer of Tests, Public Roads Administration; L. B. Jones, Engineer of Tests, Test Dept., The Pennsylvania Railroad Co.; N. L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric and Manufacturing Co.; and F. E. Richart, Research Professor of Engineering Materials, University of Illinois.

Throughout the year Committee E-10 is reviewing recommendations; consequently A.S.T.M.'s standardization developments are in a continuing stage. During the past two years, many of the important projects reviewed by Committee E-10 have involved emergency specifications and emergency alternate provisions (pink slips).

Notes on a number of the actions approved in August appear below. All of the new items, of course, will be published in the 1944 Book of Standards (the new tentative standards in the back portion of the Book; the proposed tentative revisions of formal standards appearing last in each of the respective volumes). Any revisions that have been accepted in tentative standards are incorporated immediately and the complete specification published. Just how soon separate copies of the items will be available depends upon the progress of the Book of Standards with its many editing ramifications—and also, anything of a printed nature in these days must be related to the printer's backlog of press work.

For complete list of current Emergency Specifications and Emergency Alternate Provisions, see pages 59 and 60. Several recent emergency provisions are published in full on page 54.

Expansion of Standards Activities

One of the responsibilities of the Society's Committee on Standards is to direct general expansion and promotion of the Society's standardization activities. Comments are being solicited from many of the members who would be interested concerning the initiation of standardization work in new fields.

Steel

Intensive work by various subcommittees and sections in Committee A-1 on Steel culminated in the two new tentative specifications for carbon-steel and alloy-steel blooms, billets, and slabs for forgings which replace the existing billet specifications A 248. An emergency provision will accompany the alloy specification giving a complete list of NE steels. The section in charge, headed by L. E. Ekholm with the close cooperation of A. O. Schaefer, has achieved what is felt will be much more acceptable specifications since they are considerably modernized, including in each case sections with supplementary requirements that have not previously been included in standards—special requirements that can be invoked by the purchaser. There has been no attempt to set up a simplified list of steels because of the extremely wide usages of materials for reforging purposes.

Rapidly increasing use of magnetic particle testing and inspection in the evaluation of heavy forgings and steel castings is indicated by the two new tentative standards in these fields, the one on forgings having been developed in a special section headed by C. N. Ring, Magnaflux Corp.; the one on castings by A. P. Spooner, Bethlehem Steel Co. It is hoped the practices set up in these methods will bring about a much closer meeting of the minds on the part of producers and consumers and aid in bringing some order out of admittedly varied ideas and opinions. No attempt is made to set up standards of rejection because each product and, in fact, every indication developed by the test must be individually evaluated. While the methods differ somewhat in arrangement, there are no basic differences and eventually the Steel Committee hopes to be able to develop a monograph on magnetic particle testing in which will be specific recommendations applicable to various steel products. The document on castings is supplemented by a series of photographs which should be of much value to those concerned with castings and other steel products.

As this Bulletin goes to press, four new specifications covering various types of stainless steel tubing are in the

ACTIONS BY COMMITTEE E-10 ON STANDARDS

Unless noted all actions approved at Committee E-10 meeting on August 28, 1944.

New Tentative and Emergency Standards

Committees responsible are indicated after serial designations of standards.

Ferrous and Non-Ferrous Metals

Specifications for:

- Carbon-Steel Blooms, Billets and Slabs for Forgings (A 273 – 44 T) (A-1)
- Alloy-Steel Blooms, Billets and Slabs for Forgings (A 274 – 44 T) (A-1)
- Lightweight and Thin-Sectioned Gray Iron Castings (A 190 – 44 T) (A-3)
- Malleable Iron Flanges, Pipe Fittings, and Valve Parts (A 277 – 44 T) (A-7)

Methods for:

- Magnetic Particle Testing and Inspection of Commercial Steel Castings (A 272 – 44 T) (A-1)
- Magnetic Particle Testing and Inspection of Heavy Forgings (A 275 – 44 T) (A-1)
- Determining the Resistivity of Copper and Copper Alloy Electrical Conductors (B 193 – 44 T) (B-1)

Clay Pipe; Cement

Specifications for:

- Masonry Cement (C 91 – 44 T) (C-1)
- Standard Strength Clay Sewer Pipe (C 13 – 44 T) (C-4)
- Extra Strength Clay Pipe (C 200 – 44 T) (C-4)

Petroleum Products and Lubricants

Tentative Methods of:

- Test for Chlorine in Lubricating Oils by Bomb Method (D 808 – 44 T)
- Chemical Analysis for Phosphorus in Lubricating Oils (D 809 – 44 T)
- Chemical Analysis for Lead, Copper, and Iron in Lubricating Oils (D 810 – 44 T)
- Chemical Analysis for Metals in Lubricating Oils (D 811 – 44 T)

Emergency Method for:

- Determination of Isopentane and Benzene Insolubles in Used Lubricating Oils (ES – 42) (D-2)

Road and Paving Materials and Soils; Timber

Methods of:

- Test for Determining Cement Content of Soil-Cement Mixtures (D 806 – 44 T) (D-4, D-18)
- Testing Veneer, Plywood, Wood and Wood-Base Laminated Materials (D 805 – 44 T) (D-7)

Electrical Insulating Materials; Water

Emergency Specifications for:

- Communication and Signal Pin-Type Lime-Glass Insulators (ES – 41) (D-9)

Method for:

- Embrittlement Testing of Boiler Water (D 807 – 44 T) (D-19)

Revisions in Existing Tentative Standards

(Incorporated Immediately)

Tentative Specifications for:

- Seamless Alloy-Steel Pipe for Service at Temperatures from 750 to 1100 F. (A 158 – 44 T)
- Carbon-Steel Seamless Drum Forgings (A 266 – 44 T)
- Oxygen-Free Electrolytic Copper Wire Bars, Billets, and Cakes (B 170 – 43 T) (September 21)
- Expanded or Exfoliated Mica Thermal Insulating Cement (C 196 – 44 T)
- Vinyl Chloride-Acetate Resin Sheets (D 708 – 44 T)
- Vinyl Chloride-Acetate Molding Compounds (D 728 – 44 T)
- Asphalt Roofing Surfaced with Powder Talc or Mica (D 224 – 44 T)
- Asphalt Shingles Surfaced with Coarse Mineral Granules (D 225 – 44 T)
- Asphalt Roofing Surfaced with Coarse Mineral Granules (D 249 – 44 T)

Tentative Methods of:

- Testing Asphalt Roll Roofing, Cap Sheets, and Shingles (D 228 – 44 T)

Tentative Revisions of Standards

(Not incorporated, but published for comment.)

Standard Specifications for:

- Steel for Bridges and Buildings (A 7 – 42)
- Mild Steel Plates (A 10 – 39)
- Low-Tensile Strength Carbon-Steel Plates of Structural Quality for Welding (A 78 – 43)
- Low-Alloy Structural Steel (A 242 – 42)
- Commercial Quality Hot-Rolled Bar Steels (A 107 – 42)
- Commercial Cold-Finished Bar Steels and Cold-Finished Shafting (A 108 – 36)
- Electric-Fusion-Welded Steel Pipe (Sizes 8 in. to but not including 30 in.) (A 139 – 42)
- Carbon-Steel Forgings for General Industrial Use (A 235 – 42)
- Carbon-Steel Forgings for Locomotives and Cars (A 236 – 42)
- Alloy-Steel Forgings for General Industrial Use (A 237 – 42)
- Alloy-Steel Forgings for Locomotives and Cars (A 238 – 42)
- Carbon-Steel and Alloy-Steel Ring and Disk Forgings (A 243 – 43)
- Wrought Iron Plates (A 42 – 39)
- Wood to Be Used as Panels in Weather Tests of Paints and Varnishes (D 358 – 38)
- Zinc Sulfide Pigments (D 477 – 41)

Methods of:

- Tests for Magnetic Properties of Iron and Steel (A 34 – 42) (September 15)

Withdrawals

Tentative Specifications for:

- Lightweight and Thin-Sectioned Gray Iron Castings (A 190 – 40)
- Carbon-Steel and Alloy-Steel Blooms, Billets and Slabs for Forgings (A 248 – 41 T)
- Copper-Base Alloys in Ingot Form for Sand Castings (EA – B 30)
- Clay Sewer Pipe (C 13 – 40)

New and Revised Emergency Alternate Provisions

Standard Specifications for:

- Carbon-Steel Plates for Stationary Boilers and Other Pressure Vessels (EA – A 70b)
- Seamless Alloy-Steel Pipe for Service at Temperatures from 750 to 1100 F. (EA – A 158a)
- Seamless Alloy-Steel Boiler and Superheater Tubes (EA – A 213a)
- Atomic-Hydrogen-Arc-Welded and Electric-Resistance-Welded Alloy-Steel Boiler and Superheater Tubes (EA – A 249a)
- Alloy-Steel Blooms, Billets and Slabs for Forgings (EA – A 274)
- Bronze Castings for Turntables and Movable Bridges and for Bearing and Expansion Plates of Fixed Bridges (B 22 - 44 T)
- Steam or Valve Bronze Castings (EA – B 61a)
- Composition Brass or Ounce Metal Castings (EA – B 62b)

Standard Methods of:

- Cloud and Pour Points (EA – D 97)

Tentative Specifications for:

- Tin-Bronze and Leaded Tin-Bronze Sand Castings (EA – B 143b)
- High-Leaded Tin-Bronze Sand Castings (EA – B 144b)
- Leaded Red Brass and Leaded Semi Red Brass Sand Castings (EA – B 145b)
- Leaded Yellow Brass Sand Castings for General Purposes (EA – B 146b)
- Asphalt Roofing Surfaced with Coarse Mineral Granules (EA – D 249b)
- Asphalt Roofing Surfaced with Powdered Talc or Mica (EA – D 224b)

Withdrawal of Emergency Alternate Provisions

Standard Specifications for:

- Boiler and Firebox Steel for Locomotives (EA – A 30)
- Steel Tie Plates (EA – A 67)
- Carbon-Steel Plates for Stationary Boilers and Other Pressure Vessels (EA – A 70)
- Carbon-Silicon Steel Plates of Ordinary Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels (EA – A 201)
- Chrome-Manganese-Silicon (CMS) Alloy-Steel Plates for Boilers and Other Pressure Vessels (EA – A 202)
- Low-Carbon Nickel-Steel Plates for Boilers and Other Pressure Vessels (EA – A 203)
- Molybdenum-Steel Plates for Boilers and Other Pressure Vessels (EA – A 204)
- High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels (Plates $4^1/_2$ in. and Under in Thickness) (EA – A 212)
- Hot-Worked High-Carbon Steel Tie Plates (EA – A 241)

Lightweight and Thin-Sectioned Gray-Iron Castings (EA – A 190)
Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (EA – A 116)
Zinc-Coated (Galvanized) Iron or Steel Barbed Wire (EA – A 121)
Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft (EA – B 8)
Castings of the Alloy: Copper 88 per cent, Tin 8 per cent, Zinc 4 per cent (EA – B 60)
Rolled Copper-Alloy Bearing and Expansion Plates for Bridge and Other Structural Uses (EA – B 100)
Phosphor Bronze Sheet and Strip (EA – B 103)

Tentative Specifications for:

Cartridge Brass Sheet, Strip, and Disk (EA – B 19)
Brass Sheet and Strip (EA – B 36)
Leaded Brass Sheet and Strip (EA – B 121)
Copper-Base Alloy Forging Rods, Bars, and Shapes (EA – B 124)
Cartridge Brass Cartridge Case Cups (EA – B 129)
Gilding Metal Sheet and Strip (EA – B 130)
Gilding Metal Bullet Jacket Cups (EA – B 131)
Copper Rods, Bars, and Shapes (EA – B 133)
Brass Wire (EA – B 134)
Phosphor Bronze Rods, Bars, and Shapes (EA – B 139)
Copper-Nickel-Zinc Alloy Rod and Wire (EA – B 151)
Copper Sheet, Strip, and Plate (EA – B 152)
Phosphor Bronze Wire (EA – B 159)
Aluminum Bronze Sheet and Strip (EA – B 169)
Aluminum-Base Alloy Die Castings (EA – B 85a)
Zinc-Base Alloy Die Castings (EA – B 86b)
Asphalt Shingles Surfaced with Coarse Mineral Granules (EA – D 225)
Built Soap, Powdered (EA – D 533)

Tentative Methods of:

Testing Asphalt Roll Roofing, Cap Sheets, and Shingles (EA – D 228)

Withdrawal of Emergency Specifications

Emergency Specifications for:

Lead-Coated and Lead-Alloy-Coated Copper Wire for Electrical Purposes (ES – 1a)
Lead Coating (Hot-Dip) on Iron or Steel Hardware (ES – 2)
85 Per Cent Magnesia Thermal Insulating Cement (ES – 8)
Long Fiber Asbestos Thermal Insulating Cement (ES – 9)
Mineral Wool Thermal Insulating Cement (ES – 10)
Expanded or Exfoliated Mica Thermal Insulating Cement (ES – 11)
Diatomaceous Silica Thermal Insulating Cement, for Use from 600 to 1200 F. (ES – 12)
Diatomaceous Silica Thermal Insulating Cement, for Use from 1200 to 1900 F. (ES – 13)
Malleable Iron Flanges, Pipe Fittings, and Valve Parts (ES – 20)

Emergency Method of:

Conducting Salt-Spray Tests on Organic Protective Coatings (ES – 3) (September 27)
Test for Chlorine in Lubricating Oils by Bomb Method (ES – 36)
Chemical Analysis for Phosphorus in Lubricating Oils (ES – 37)
Chemical Analysis for Lead, Copper, and Iron in Lubricating Oils (ES – 38)
Chemical Analysis for Metals in Lubricating Oils (ES – 39)

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process of approval by the Committee on Standards. These items have cleared through Committees A-1 on Steel and A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.

Emergency actions included the withdrawal of the provision restricting the use of copper in steel tie plates and high-carbon tie plates; the establishment of emergency grades in the alloy boiler tube specifications A 213, seamless, and A 249, electric-welded; and also emergency provisions in the alloy high-temperature pipe specifications A 158. In these three cases the grades primarily affected are the austenitic alloys of the stainless classifications where compositions eventually will be brought in line with the four new stainless tubing specifications.

Numerous tentative revisions of standard specifications were accepted, notably in the commercial bar specifications A 107, hot-rolled, and A 108, cold-rolled, where clarifying scope clauses and, information on chemical analysis eventually are to be incorporated; more recent steel compositions will be established (although it was pointed out that the existing grades are not far out of line with current practice) and of particular interest will be the inclusion as appended information, of data on tensile properties which might under normal conditions be expected, together with some indication of appropriate uses of the various grades. Changes which will eventually be incorporated in several forging specifications involve clarification of retests when flaws develop in the tensile specimen. In several structural specifications somewhat larger reduction in elongation will eventually be permitted for thin sections.

The electric-fusion-welded pipe standard covering material up to 30 in., A 139, will eventually include material now in emergency provisions EA-A 139a, Committee E-10 as a preliminary step having approved the issuance of this material as a tentative revision.

Wrought, Cast, and Malleable Iron

The current specifications for wrought-iron plates (A 42) permit reductions in tensile strength as the thickness increases, but no such reduction has been permissible for yield point. This requires a higher yield point-tensile strength ratio on thicker plate which is at variance with the actual properties developed. For this reason modifications of the standard are to be published as tentative. What Committee A-2 plans is a requirement that the yield point shall in no case be less than half the tensile strength.

While Committee A-3 on cast iron had hoped to have its new specifications for material for pressure containing parts up to 650 F. completed, this was not possible. However, tentative specifications for lightweight and thin-sectioned gray iron castings were approved replacing the existing standard A 190, incorporating the material that was issued as emergency alternate. This clarifies the intent on physical testing of the material.

Committee A-7 on Malleable-Iron Castings developed in 1942 as an emergency matter requirements for malleable iron flanges, pipe fittings, and valve parts (ES – 20), the intent being to have purchase requirements established so that these materials might be used and conserve certain other more strategic metals. The emergency standard has now been accepted as a regular tentative specification, with the designation A 277. The manufacturer may supply material either in accordance with the standard A 197 (cupola malleable iron) or the specifications A 47.

Copper Conductors, Die Castings, Cast and Wrought Copper Products

The new Tentative Method for Determining the Resistivity of Copper and Copper Alloy Electrical Conductors, B 193, should be of considerable help to the industry. The new method which covers apparatus, test specimens, and methods to be followed is intended to have an accuracy of 0.50 per cent for material with resistance of 0.00001 ohm or more.

Because of the tentative specification accepted at the Annual Meeting covering lead and lead-alloy coated copper wire, B 189, the emergency specifications ES – 1a have been withdrawn.

Other emergency provisions applicable to zinc-base and aluminum-base die castings, A 86 and A 85, respectively, also have been dropped because of incorporation of the emergency requirements in the regular specification.

In the early war period, Committee B-5 on Copper and Copper Alloys established some 16 emergency provisions permitting use of fire-refined copper, so-called Braden copper, as set up in emergency specifications ES - 7 for the production of a number of products. With the establishment of these provisions right in the standards and tentative standards, which action was taken at the Annual Meeting, the large number of emergency provisions can be withdrawn as shown in the accompanying list.

Among the actions reported at the Annual Meeting were revisions in widely used copper and brass casting specifications to bring them in line with standard alloy compositions sponsored by the Conservation Division of the WPB. These analyses and corresponding properties as a result will now be substantially the same for Navy, Federal and SAE requirements. Because many of the changes previously had been adopted as emergency matters, it is possible to delete many requirements from the emergency provisions except that the use of cast-to-size test bars is being continued as an emergency provision. See the accompanying list for designations withdrawn.

Cement, Thermal Insulating Materials, Clay Pipe

Although important changes in provisions for masonry cement resulted in a decision to issue new specifications, the existing standard C 91 - 40 is being continued. One important achievement in the new tentative specification is a much closer agreement between Federal and A.S.T.M. requirements, there having been cooperation between the respective committees concerned. The three major changes involve an increase in the flow of 100 to 115 per cent instead of the present requirement of 65 to 80 per cent. Among other reasons for this modification, greater uniformity in the strength tests should result. Also, repeated tests on mortar for brickwork have shown a flow equal to or greater than the requirement. Compressive strength requirements have been raised to the values of 400 and 750 psi., respectively, for the 7-day and 28-day strength requirements compared with the values in the standard of 350 and 600 psi. Even the new values are less than the general use type in the Federal document. Because in the production of good brickwork a mortar possessing high water retentivity is considered desirable, this requirement is now to be a minimum of 70 per cent instead of the current value of 65 per cent. Effects of water retentivity of mortars on ease of construction have been covered in the National Bureau of Standards' BMS Report No. 82.

Two important recommendations from Committee C-4 on Clay Pipe involve new tentative standards for extra strength material and revised specifications for standard strength clay sewer pipe which replace the current standard C 13. Extra strength vitrified clay pipe has been an item of extensive manufacture and use for more than ten years. This material is akin to vitrified clay sewer pipe, standards for which are now in effect under the designation C 13 - 40. Extra strength pipe varies from that covered by Standard C 13 - 40 in that it is considerably heavier and is intended to sustain much higher working loads. The United States Government especially and several other agencies have adopted their own specifications for this material. The standards recommended for extra strength pipe are identical, with but one or two very minor exceptions, with Federal Specification for Clay Pipe, SS-P-361a. The specifications for standard strength sewer pipe provide for increasing the width of joint spaces to improve both the product and the quality of the finished installation. Proposed revisions eliminate the need of cross-references for computing minimum and maximum dimensions.

Because five new tentative specifications for thermal insulation accepted at the Annual Meeting virtually replace emergency specifications, the latter have been withdrawn—see the adjoining list.

Paints; Petroleum Products

The tentative revisions accepted for publication for a year or more in the Standard Specifications for Zinc Sulfide Pigments (D 477) will allow for the addition of surface treating agents which give improved pigment properties. Another tentative revision involving requirements for wood to be used as panels in weather tests of paints and varnishes (D 358) enlarges the specifications to include redwood panels. Wood used in these tests may be for either outdoor exposure or accelerated laboratory tests and since wood which is used as the test surface has a marked bearing on the results, uniform specifications have proved desirable. When the revision is adopted next year or later, there will be four general classes, western red cedar, certain types of white pine, southern yellow pine, and redwood.

Committee D-2 on Petroleum Products and Lubricants has developed an emergency alternate provision in the test for cloud and pour points (D 97) the emergency making it suitable for expediting evaluation of very low pour points. The new emergency method of test for isopentane, benzene, and their inorganic insolubles in used lubricating oil (ES - 42) is urgently needed for use in connection with the C.L.R. engine procedures for the qualification of heavy duty oils for use by the Armed Forces. These qualifying engine tests require analyses of the used oils for insoluble oxidation products and contaminating materials, such as soot. The present analytical method incorporated in the engine test procedure gives incorrect results, particularly in regard to the extrinsic insolubles. The C.L.R. engine test procedure is now ready for publication in revised form, and the Ordnance Department has requested its immediate release. As the revised method should refer to or incorporate an A.S.T.M. method for the analysis of used oils, need for the new method is evident. A report by L. L. Davis, chairman of the subcommittee in charge, submitted to Committee D-2 included data from cooperative tests.

Soil Cement Mixtures

The new Test for Determining Cement Content of Soil-Cement Mixtures (D 806) was developed jointly by Committees D-4 on Road and Paving Materials and D-18 on Soils for Engineering Purposes. The method covers determination of the cement content of mixtures that have been sampled from a project under construction or after completion, determination being made chemically. Increasing use of these methods of construction makes this new test method pertinent.

Test for Veneer, Plywood, etc.

The new Methods of Testing Veneer, Plywood, Wood- and Wood-Base Laminated Materials (D 805) were published as information in the preprinted annual report of Committee D-7 on Wood (formerly D-7 on Timber). An explanatory note with the methods is given below. Much of the development work was carried out at the Forest Products Laboratory under the direction of L. J. Markwardt, who is Secretary of the committee.

"The expanding use of plywood, wood- and wood-base laminated materials has stimulated an interest in the mechanical properties of these materials, and in methods for evaluating their mechanical properties. In the preparation of these methods of test, special consideration has been given to procedures already in satisfactory use in the determination of the mechanical and physical properties. Consideration has been given also to the correlation of the methods with related procedures already in use or under consideration for other materials.

"The mechanical tests described in these methods may be made to obtain strength data for design purposes, to determine the effect on strength of various treatments or of various factors in processing, to ascertain properties in relation to the various grain or fiber directions of the material, to compare the properties of different base materials or different species, and for other similar purposes."

Waterproofing and Roofing Materials

Several emergency provisions have been issued involving specifications for asphalt roofing and shingles, in order to expedite procurement of these materials. Committee D-8 on Bituminous Waterproofing and Roofing materials has recommended, and this was approved, that two of the emergency provisions, EA–D 225, covering asphalt shingles surfaced with coarse mineral granules and EA – D 228a, covering testing asphalt roll roofing, cap sheets, and shingles be incorporated in the respective tentative standards; that the portion of the emergency alternate applicable to the specification for asphalt roofing surfaced with powdered talc or mica, D 224, involving weight be abandoned; and for asphalt roofing surfaced with coarse mineral granules, D 249, the emergency is to be continued with revisions, and similar changes are being made in the specifications.

Glass Insulators

Committee D-9 on Electrical Insulating Materials has developed a series of standards covering various types of glass insulators, namely, Tests for Pin-Type Lime Glass Insulators (D 468), Methods of Testing Glass Spool Insulators (D 550), and Specifications for Low and Medium-Voltage Pin-Type Lime Glass Insulators (D 730). The new emergency specifications (ES – 41) supplement these standards by covering communication and signal pin-type materials. These specifications were developed in cooperation with the Signal Corps, and U. S. Army Specifications No. 71-4953 issued on August 7 are in accord with the recommendations. Requirements given cover the thermal shock, electrical characteristics, dimensions, etc. Considerable details cover packaging and methods of testing.

Embrittlement Testing of Boiler Water

These new methods for embrittlement testing of boiler water (D 807) culminate a most extensive investigation carried on by the Joint Research Committee on Boiler Feedwater Studies over a period of some ten years. Operators of boiler plants have experienced cracking of boiler sheets and boiler tube ends, etc., for several decades and there has been very pronounced interest in this whole activity. In much of the work the United States Bureau of Mines took an active part through its research stations and technologists, and the new test incorporates the embrittlement detector which was developed by two Bureau investigators, W. C. Schroeder and A. A. Berk. Nonexclusive licenses for the manufacture and distribution are given at the discretion of the Secretary, U. S. Department of the Interior. There has been considerable material published in the A.S.T.M. *Proceedings* and in the publications of other organizations concerned describing work on embrittlement and also the detector.

Revised Plastic Specifications

The various revisions developed by Committee D-20 on Plastics involving Specifications for Vinyl Chloride-Acetate Resin Sheets (D 708), Laminated Thermosetting Materials (D 709), and Vinyl Chloride-Acetate Molding Compounds (D 728), are intended to bring the specifications up to date. Since these items are tentative, the changes will be incorporated in the specifications as published in the 1944 Book of Standards and in the special compilation of standards sponsored by Committee D-20 which it is hoped can be issued in January, 1945.

Welding Publications

Three recent publications from the American Welding Society cover, respectively, "Rules for Fusion Welding Piping in Marine Construction"; a "Tentative Report on Structural Failures in Welded Ship Construction"; and "Tentative Report on Weldability Standards for Alternate Aircraft Steels."

The rules on ship pipe welding cover plain carbon steel material with a maximum carbon content of 0.35 per cent. The report on structural failures in ship construction is concerned primarily with factors causing failure and the question of stress concentrations is dealt with in some detail. The tentative standard on weldability of alternate aircraft steels is presented as a satisfactory weldability test to compare proposed alternate steels with the standard steels.

Copies of each of these items can be obtained from the A.W.S. Office, 33 West 39th St., New York 18, N. Y., for 25 cents each.

United States Mineral Policy

Many A.S.T.M. members were interested in the guest address presented at the 1944 Annual Meeting in June by Dr. Charles K. Leith, who discussed in detail the question of "Minerals in War and Peace." At the request of the State Department, according to *Mining and Metallurgy*, Dr. Leith, in a personal capacity, is bringing together from reliable sources various recommendations with respect to our foreign mineral policy.

The Brookings Institute is aiding in this work. The aim is to provide a consensus of opinion on this vitally important subject. Incidentally, the September issue of *Mining and Metallurgy* comments on some statistics that have been rather widely publicized dealing with the United States resources in metals and minerals, pointing out that the values need to be reviewed very circumspectly since among other reasons they apparently have not been officially approved.

Publications Issued or Imminent

SEVERAL new A.S.T.M. publications have been issued including the special compilation of standards on Coal and Coke, and Textile Materials, and the compilation on Procedures for Testing Soils. Two other books of great interest to specific groups of members and other technologists are the Report on Standard Samples for Spectrographic Analysis by Messrs. Brode and Scribner and the monograph entitled "Significance of Tests of Paper and Paperboard." These two books are on press and distribution may begin at about the time this BULLETIN goes in the mails.

Condensed notes on these publications appeared in the August BULLETIN, but some additional comments will be of interest.

Standard Samples for Spectrographic Analysis:

This report, based on work sponsored by the War Metallurgy Committee, is the result of very extensive surveys conducted by Professor W. R. Brode, of Ohio State University. Cooperating with him in preparing the report as published by the Society is Bourdon F. Scribner, National Bureau of Standards; both are active in the work of Committee E-2 on Spectrographic Analysis. E-2's Subcommittee V on Standards and Pure Materials was responsible for directing the attention of the War Metallurgy Committee to this important subject. The project and consequently the report had two purposes—*first*, the collection and dissemination of information on available standard samples, and *secondly*, the initiation and encouragement of further development of standard samples to meet the particular demands of war production.

Following an introduction with a discussion of definitions and nomenclature, there is a survey on available standard samples with the status of each group of materials being discussed. Sections on the following available standards are covered: Iron and Steel; Aluminum and its Alloys; Magnesium and its Alloys; Copper, Brass, and Bronze; Tin, Lead, and Zinc Alloys.

In the sixth section entitled "Miscellaneous Materials," a variety of samples is listed. These include ceramic materials, steel-making alloys, ores, refractories, and synthesized mixtures, salts, and solutions. At the end of this section are listed some sources of rare chemicals, powdered metals, and pure metals useful in preparing spectrographic standard samples. Finally, there is appended a compilation of spectral line pairs employed in the analysis of certain of the materials discussed in this report. Many important data are listed in numerous tables.

Copies of this 30-page report in heavy paper cover can be obtained by members at 55 cents; list price, 75 cents.

Procedures for Testing Soils:

The material in this book developed under the auspices of Committee D-18 on Soils for Engineering Purposes is arranged in five general classifications. Under each section will be found, first, the standard methods if any, as issued by the Society and then suggested methods. The latter represent available test procedures that have been used with some degree of success for the determinations in question and are presented in this publication only as information. After further study, these suggested procedures may lead to formal A.S.T.M. methods. The soil test procedures fall into five categories, each pertaining to a particular type of testing, as follows: Part I, Indicator Tests; Part II, Compaction and Consolidation Tests; Part III, Strength Tests; Part IV, Tests for Soil-Cement; Part V, Tests for Soil-Bituminous Mixtures.

Several members of Committee D-18 constitute the Committee in charge of the symposium, of which this compilation is a preliminary step, the symposium to be held at a forthcoming meeting of the Society; F. C. Lang, University of Minnesota, is committee chairman. C. A. Hogentogler, Chairman of Committee D-18, also devoted much effort to guiding the publication. This 260-page publication is available in heavy paper cover to members, at $1.50; list price, $2.25 per copy.

Paper and Paperboard:

This publication culminates many months of intensive work by Committee D-6 on Paper and Paper Products, giving as it does authoritative information on the characteristics, nomenclature, and significance of tests on paper and paperboard. It should be of widespread interest in this very extensive field, not only to consumers but to producers of paper products as well. This 170-page publication can be purchased by members at $1.00 per copy; the list price is $1.50.

Standards on Coal and Coke:

This 130-page publication includes all of the standard tests and specifications developed by Committee D-5 on Coal and Coke involving sampling methods, chemical analysis, test methods, specifications, classifications, and definitions. The Society is a recognized agency for standard methods of testing coal and coke. Committee D-5, which developed the standards included, is engaged actively in the further improvement of the methods and specifications and in the development of additional tests, in particular for the plasticity and swelling of coal, the ignitability of coal and coke, and methods of sampling coal. Copies of this compilation can be obtained by members at $1.00 per copy; to nonmembers, $1.50.

Standards on Textile Materials:

In addition to all of the some 80 standards developed by Committee D-13 covering many of the widely used products of this industry, including cotton, rayon, wool, asbestos, glass, and other materials, this compilation issued annually gives much other related information. For example, there are seven proposed methods published for information and comment in this 1944 book, such as a test for accelerated aging, a recommended universal yarn numbering system, and a test for diffuse transmission of blackout materials. There are also five technical papers presented at committee meetings, covering Cotton Testing Service, Cotton Manufacturers Raw Material Problem, Quality Control in the Supply of Textiles to the Armed Forces, Cotton Testing Service from the Viewpoint of the Cotton Breeder, and the Grex Universal Yarn Numbering System. Numerous tables of data, photomicrographs, definitions of terms, etc., complete this 450-page book which is available to members at $1.80 per copy; to nonmembers $2.75.

The Application of Grain-Size Determination to Magnesium Alloys

By C. H. Mahoney[1] and A. L. Tarr[1]

Editor's Note.—Attention is called to another paper on this subject by P. F. George on "A Numerical Rating Method for the Routine Metallographic Examination of Commercial Magnesium Alloys," ASTM Bulletin No. 129, August, 1944, p.35.

The subject of grain size of metals has been the object of intensive interest for a number of years. It has been more thoroughly investigated in steels than in the non-ferrous alloys, and generally in the latter group investigation has been limited, from the standpoint of extensive research, to wrought copper alloys. The influence of grain size on the properties of steels has been well recognized and accepted. Bain and Vilella state[2] that this ferrous "interest came about as a response to the need for a rational understanding of those more subtle, but important, factors of steel quality which cannot be explained by the composition of the steel as ordinarily reported in the usual analysis . . . . The explanation was found to lie largely in the grain size of the austenite, established during the final heating above the critical range. The extra analytical properties finally secured depend in large part upon the actual grain size of the austenite which transforms to set up the microscopic structure existing in the heat-treated steels as tested and used."

Magnesium alloys, as is now generally understood, differ in some important respects from most other structural alloys, but it is a matter of general understanding that the finer grain structures possess superior mechanical properties, enhanced amenability to solution treatment, and improved machinability. In these respects, the metal is somewhat remindful of the austenitic steels and some of the aluminum alloys. It is peculiar, however, that once this fine grain is fixed in magnesium alloys by present superheating practices, it tends to persist in subsequent castings produced from superheated ingots, even though the secondary melt has not again been superheated to the same degree. It is also peculiar to this metal that frequently the fine grain resulting from superheating is preserved in subsequent remelting. While this phenomenon has apparently not received the attention and study that it may well deserve, and as a result is little understood, its circumstance has been confirmed.[3]

The recognition of the influence of grain size in austenitic steels resulted in the need for correlation between grain size and mechanical properties and a clear-cut means of reporting grain size for analytical purposes. Since the grain size of magnesium has such an important bearing on the mechanical properties of its alloys, it would seem of appreciable importance to establish a recognized and standard method for its recording and correlation to the mechanical properties. Its effect on mechanical properties and on possible heat-treating requirements is a highly important factor, and it is economically desirable that the magnesium producers and fabricators be able to control the grain size in the finished product and to correlate intelligently that size to necessary heat treatment and anticipated results.

Importance of a Standard Method for Measuring Grain Size

It would appear desirable from the standpoint of general benefit to the magnesium industry that the methods of reporting grain size be of such nature that the results reported, both here and abroad, be readily comparable and easily understood, whether measured by either the intercept or the micrographic comparison method.

In the United States we have the method of grain size measurements outlined in the A.S.T.M. Tentative Methods of Preparation of Micrographs of Metals and Alloys (E 2 – 39 T).[4] A planimetric or direct comparison of a micrograph or projected image with standard micrographs or network charts is recommended for material in which the grains are equiaxed, and Heyn's intercept method is recommended for material in which the grains are not equiaxed. There are two sets of standard photomicrographs provided by this Society. One set (E 2 – 39 T)[4] offered for wrought and annealed alloys illustrates grains of the twinned crystal variety in 10 sizes at 75 magnifications, ranging from 0.010 mm. to 0.200 mm. in diameter, as calculated by the Jeffries type formula for "diameter of average grain." This formula may be written as $d = \sqrt{A/M^2G}$, where G is the number of grains seen in area A at a linear magnification of M. This set of photomicrographs is generally accepted as non-ferrous grain size standards, although the Society does not so specify. The other set of standard photomicrographs (A.S.T.M. Tentative Classification of Austenitic Grain Size in Steel (E 19 – 39 T)[5]) at 100 magnifications is recommended for determining austenitic grain size and illustrates grains of a nontwinned character, designated numerically from 1 to 8 in A.S.T.M. Index Numbers, and ranging from 0.0113 in. to 0.00100 in. grain diameter. This range can be extended by the use of various magnifications other than the standard 100 diameters by means of correction factors.

There is no apparent regularity in the incremental steps of the non-ferrous standards for wrought and annealed material, and the twinned crystal illustrations are not typical of the grain structure found in magnesium alloys. It would seem desirable for purposes of analytical inter-

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

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[2] A.S.M. Metals Handbook, 1939 Edition, p. 754.

[3] Beck, "Technology of Magnesium and Its Alloys," Translation, F. A. Hughes and Co. Ltd., p. 322 (1940).

[4] 1942 Book of A.S.T.M. Standards, Part I, p. 1475.

[5] 1942 Book of A.S.T.M. Standards, Part 1, p. 1534.

TABLE I.—COMPARISON OF GRAIN SIZE STANDARDS.

Proposed Grain Size Number	Corresponding A.S.T.M. Grain Size Number (Timken)	Grains per Square Inch as Viewed at 100 Diameters			Calculated Grain Dimension, $d = \sqrt{\frac{A}{M^2G}}$, in.[a]			Grains per Square Inch as Viewed at 100 Diameters			Calculated Grain Dimension, $d = \sqrt{\frac{A}{M^2G}}$, mm.[a]			Austenitic Grain Size Dimension (A.S.T.M.)[b]		A.S.T.M. Non-Ferrous Grain Size Diameter, mm.	Non-Ferrous Grain Size Dimension[b]		British Grain Size Number and Dimension	
		min. no. $^3/_4(2^{N-1})$	mean no. 2^{N-10}	max. no. $^3/_2(2^{N-10})$	max.	mean	min.	min.	mean	max.	max.	mean	min.	in.	mm.		in. diam.	mm. diam.	No.	mm.
1	−8	0.0015	0.0019	0.0029	0.25820	0.22952	0.18570	0.0233	0.0295	0.0457	6.55122	5.82226	4.67784	...	...	...	...	...	10	5.0
2	−7	0.0029	0.0039	0.0059	0.18570	0.16013	0.13019	0.0450	0.0605	0.0915	4.71170	4.06204	3.33059	...	...	...	...	...	..	..
3	−6	0.0059	0.0078	0.0117	0.13076	0.11323	0.09241	0.0915	0.1209	0.1814	3.30592	2.87577	2.34791	...	...	...	...	...	9	3.0
4	−5	0.0017	0.0156	0.0234	0.09245	0.08006	0.06535	0.1814	0.2418	0.4627	2.34734	2.03225	1.66045	...	...	...	...	...	8	1.7
5	−4	0.0234	0.0313	0.0469	0.06537	0.05652	0.04615	0.3627	0.4952	0.7270	1.65831	1.43563	1.17283	...	...	...	...	...	7	1.2
6	−3	0.0469	0.0625	0.0938	0.04618	0.04000	0.03265	0.7270	0.9688	1.4539	1.17283	1.01490	0.82944	...	...	...	...	...	6	0.9
7	−2	0.0938	0.1250	0.1875	0.03265	0.02828	0.02302	1.4539	1.9375	2.9063	0.82944	0.71833	0.58658	...	...	...	...	...	5	0.7
8	−1	0.1875	0.2500	0.3750	0.02309	0.02000	0.01630	2.9063	3.8750	5.8125	0.58658	0.50800	0.41472	...	...	...	...	...	4	0.55
9	0	0.3750	0.5000	0.7500	0.01633	0.01414	0.01155	5.8125	7.7500	11.6250	0.41472	0.35921	0.29329	...	...	...	...	...	3	0.4
10	1	0.7500	1.0000	1.5000	0.01155	0.01000	0.00817	11.6250	15.5000	23.2500	0.29329	0.25400	0.20738	0.00922	0.2340	0.200	0.0075	0.190	2	0.3
11	2	1.5000	2.0000	3.0000	0.00816	0.00707	0.00577	23.2500	31.0000	46.5000	0.20738	0.17961	0.14664	0.00704	0.1790	0.150	0.0064	0.163	1	0.2
12	3	3.0000	4.0000	6.0000	0.00577	0.00500	0.00407	46.5000	62.0000	93.0000	0.14664	0.12700	0.10370	0.00492	0.1250	0.120	0.0050	0.127	..	..
13	4	6.0000	8.0000	12.0000	0.00408	0.00354	0.00289	93.0000	124.0000	186.0000	0.10370	0.08980	0.07332	0.00338	0.0860	0.090	0.0041	0.104	..	..
14	5	12.0000	16.0000	24.0000	0.00289	0.00250	0.00204	186.0000	248.0000	372.0000	0.07332	0.06350	0.05185	0.00251	0.0638	0.065	0.0031	0.082	..	..
15	6	24.0000	32.0000	48.0000	0.00204	0.00177	0.00144	372.0000	496.0000	744.0000	0.05185	0.04490	0.03666	0.00162	0.0412	0.045	0.0028	0.071	..	..
16	7	48.0000	64.0000	96.0000	0.00144	0.00125	0.00102	744.0000	992.0000	1 488.0000	0.03661	0.03175	0.02592	0.00112	0.0285	0.035	0.0015	0.038	..	..
17	8	96.0000	128.0000	192.0000	0.00102	0.00088	0.00072	1 488.0000	1 984.0000	2 976.0000	0.02592	0.02245	0.01833	0.00080	0.0203	0.025	0.0013	0.033	..	..
18	9	192.0000	256.0000	384.0000	0.00072	0.00062	0.00051	2 976.0000	3 968.0000	5 952.0000	0.01833	0.01588	0.01296	...	...	0.015	0.0010	0.025	..	..
19	10	384.0000	512.0000	768.0000	0.00051	0.00044	0.00036	5 952.0000	7 936.0000	11 904.0000	0.01296	0.01123	0.00917	...	...	0.010	0.0009	0.023	..	..
20	11	768.0000	1024.0000	1535.0000	0.00036	0.00031	0.00025	11 904.0000	15 872.0000	23 808.0000	0.00917	0.00794	0.00648	...	...	...	...	...	..	..
21	12	1536.0000	2048.0000	3072.0000	0.00026	0.00022	0.00018	23 808.0000	31 744.0000	47 616.0000	0.00648	0.00561	0.00458	...	...	...	...	...	..	..

[a] Abbreviation A = area, M = magnification, G = number of grains in A.
[b] By intercept.

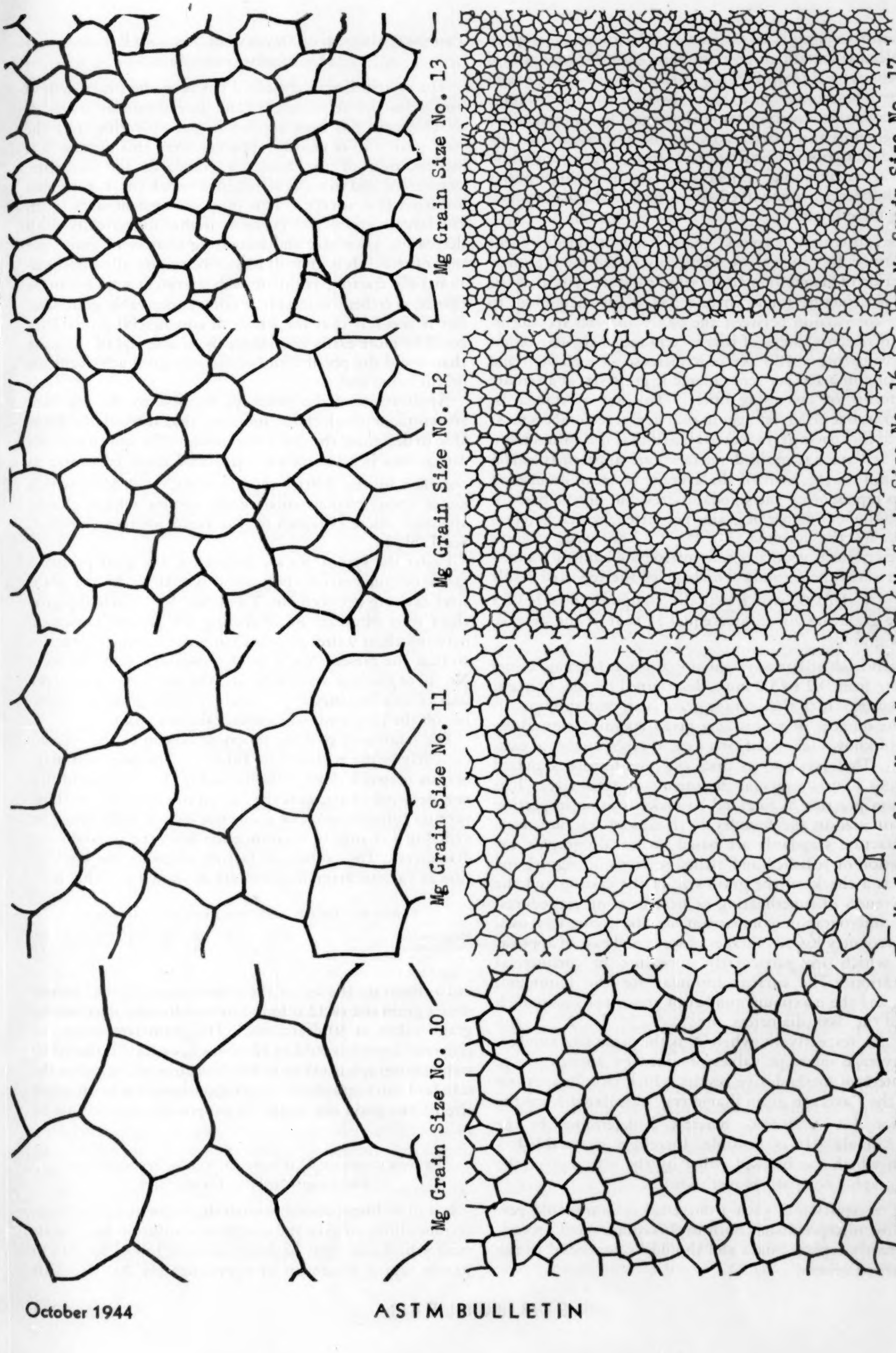

Fig. 1.—Proposed Magnesium Network Chart.

pretation to provide incremental regularity, and it is much simpler for metallographic interpretation if the standard chart is typical in appearance of the material being examined. These non-ferrous charts also have the disadvantage for magnesium interpretation that they do not extend far enough into the coarse range to include grain sizes obtained in ingots and castings made from magnesium alloys cast at unfavorable temperatures or from high-purity metal or certain unmodified alloys such as the magnesium-manganese binary.

The austenitic network charts recommended by the Society (E 19 – 39 T[5]) are admirably suited for the interpretation of magnesium alloys since they are typical of the type of structure found therein and adapt themselves to ready comparison between the chart and the specimens. The incremental steps of this system are of regular order, approximating a 41.5 per cent increase in each step and resulting in a 100 per cent change in grain size at alternate increments of increasing order. This set of standards, however, has disadvantages in that negative numbers must be used for coarse grain material, and that the values tabulated as "average grain diameters" are apparently calculated not on the basis of the average or mean number of grains representing the standard sizes, but on the basis of the minimum number of grains permitted, which is represented by the formula, $^3/_4(2^{N-1})$. The term, "grain diameter," as is generally recognized, is technically a misnomer since the formula which gives the reported result is $d = \sqrt{A/M^2G}$, which actually computes the side of a square grain having an area equal to that of the average single grain.

The British utilize a system of grain sizes for magnesium ranging from 0.2 to 5.0 mm., determined by the intercept method, in which the average grain is arrived at by counting the number of grains at a given magnification along lines of known length of two axes at right angles to each other. Their system, as does our non-ferrous standard E 2 – 39 T, uses irregular increments of grain size. It is common practice in England to make routine inspection of grain size in the foundry by means of fracture tests. The fracture standards are based on metallographic examination of polished and etched sections of ingots, and serve as a check on the grain size of the casting and the effectiveness of superheating or heat-treating procedures.

The micrographic comparison method commonly used in this country has advantages of speed and ease of application, which are particularly appealing in commercial application. The current formulas for the minimum, mean, and the maximum number of grains per square inch viewed at 100 diameters are: $^3/_4(2^{N-1})$, 2^{N-1}, and $^3/_2(2^{N-1})$, respectively, where N is the grain size number. The average intercept values obtained by application of the intercept method give results which closely approximate the "average grain diameters" calculated from the equation $d = \sqrt{A/M^2G}$, where G is determined by the 2^{N-1} formula. It is possible, therefore, to establish a system which can be used either by the intercept or the micrographic comparison methods.

The recognition of such a universal system would permit cross interpretation, both in this country and abroad, of currently reported data and should be beneficial to the industry in general.

Proposed Method of Determination and Recording of Magnesium Grain Size

The system herein presented has been the outgrowth of our industrial requirement, and in its various stages of development has been applied in our operation over the past year. It is readily apparent that this system is a modification of the Society's standards for austenitic grain sizes, and that the standard network charts presented are from that source. This proposed system starts with the largest grains and proceeds higher numerically with decreasing grain size and increasing number of grains per unit of area. It is difficult to ascribe empirically a designation to a starting point of such a system which can be chosen as either the largest or finest conceivable grain size, but it was felt that the limits of commercial probability could be more easily defined on the coarse end of the scale than could the possibilities of metallurgical achievements on the other end.

Application of the intercept method to the standard austenitic network charts indicates that it would be desirable to designate the grain size numerically and to state its dimensions in terms of the calculated mean grain size as obtained by the Jeffries type formula, $\sqrt{A/M^2G}$, which under these circumstances gives results which closely approach those obtained by the Heyn intercept method. See Table I.

Under the system we are proposing, the most probable range of commercial application would lie in the grain sizes existing between No. 7 and No. 16. These designations were obtained by relabeling the present austenitic network chart 9 sizes greater than is the austenitic practice so that the present No. 1 on the austenitic scale becomes No. 10 of the new standards, and the number of grains per unit of area becomes 2^{N-10}, where N is the grain size number on the proposed magnesium network chart.

The relationship of the proposed system to the systems currently in use is shown in Table I. The proposed magnesium network chart is shown in Fig. 1. The use of this new network chart, as is the case in the austenitic system, permits interpretation of grain size over a wide range by utilizing a change in magnification from the standard 100 diameters. The correction factors necessary for application at various magnifications are as shown in Table II:

TABLE II.—GRAIN SIZE CORRECTION FACTORS.

Magnification	6.25	12.5	25	50	100	200	400	800
Correction	−8	−6	−4	−2	0	+2	+4	+6

To illustrate the use of these correction factors, assume that a grain size of 12 is found to match a specimen micrograph taken at 50 diameters. The grain size under the proposed system would be 12 minus 2, or 10. If the specimen micrograph is taken at 400 diameters and matches the standard micrograph of the proposed system with grain size 10, the grain size under the proposed system would be 14.

Preparation of Magnesium Alloy Specimen for Determining the Grain Size

It will be found desirable with the majority of cast magnesium alloys to give the specimen a solution heat treatment which can then be beneficially followed by a 15 to 30-min. aging treatment at approximately 200 C. This

preparation permits a definite outline of the grain structure and allows much more positive results than can possibly be obtained on unheat-treated specimens.

Various techniques have been prescribed for the preparation of magnesium alloys for metallographic examination. All previously recommended procedures with which we are familiar present difficulties which induce uncertain accomplishment, and which can be avoided by following the technique herein outlined. The specimen may be cut to approximate size and then filed to a plane surface, taking care not to cold work or deform the specimen in its interior. The specimen should then be fine-ground, using Nos. 1, 0, 00, and 000 emery papers. The specimen should be wiped carefully between each paper and rotated 90 deg. in proceeding to the subsequent paper. Caution should be taken to use a minimum pressure to avoid work deformation of the structure.

Polishing may then be carried out on one horizontal rotating lap, using Selvyt cloth and metallographic alumina. Only sufficient water should be used to keep the cloth moist, and the amount of abrasive should be kept to a minimum. A small quantity of the abrasive should be worked into the cloth with the finger tips to charge about a 2-in. area at the approximate center. The lap should preferably rotate at approximately 200 rpm. Hold the specimen gently but firmly against the lap and rotate the specimen counter to the lap at a gradually increasing distance from the lap center. If the conditions are proper for polishing, the lap will slowly but evenly become darkened by the lappings. Under proper working conditions, the cutting action can readily be detected by sensitive finger tips, and if such indications are not present, it can be taken as evidence that either excessive quantities of water or alumina are being used. The finished specimen may be first washed with water, then alcohol, and dried in a warm air blast. After the metallographer has developed familiarity with the technique outlined, the usual magnesium specimen should not require more than 3 to 6 min. for preparation.

The etching reagent required will depend on the alloy to be etched and its condition. In the case of most magnesium alloys containing aluminum and zinc, a solution treatment, followed by a short aging at 200 C., sensitizes the grain boundaries to quick etching attack. Alloys containing aluminum up to 7 per cent and a maximum 3 per cent zinc respond very well to a diphosphate etching solution. This reagent is made up to contain 24 g. of monobasic sodium phosphate, 4 g. of potassium ferricyanide, and 100 g. of distilled water. The reagent is used as a dip etch unless staining occurs, in which case a cotton swab is preferable. This reagent has been previously recommended for bringing out the macrostructure of magnesium welds and, to our knowledge, has not been previously suggested for micro-etching.

Alloys having an aluminum content above 7 per cent usually respond more readily to a phospho-picral reagent. This contains 4 g. of picric acid and 0.7 ml. of phosphoric acid of 1.7 specific gravity in 100 ml. of ethyl alcohol. It should be applied by swabbing. The grain structure of sheet alloys, such as BMI-11 and BMI-8X, responds well to this etch.

Excellent results have been obtained with a glycol reagent in those cases where it is desired to bring out the minor constituents, eutectic structure, or other structures than grain boundaries. This reagent is made up from 1 ml. of concentrated nitric acid, 75 ml. of ethylene glycol, and 24 ml. of distilled water.

A 2 per cent nital reagent is used in England as a general-purpose etchant for control work. This is a highly sensitive etchant which requires precise and exact attention in order to produce consistent results free from pitting. For this reason, we do not recommend it for routine work. We have found that this reagent is good for cleaning up stained specimens which it is desired to photograph. There is a reference[6] to a German standard etching solution of 0.5 per cent nitric acid in alcohol which may be more suitable for routine work.

It is advisable occasionally to check the metallographic accomplishment after the determination of the grain size by deforming the specimen slightly in a vise so as to produce slip lines. If the true grain structure has not been brought out by the technique of the operator, this will be disclosed by the slip lines established, since these lines will terminate at the actual grain boundaries.

[6] *Z. Metalkunde*, Vol. 33, January, 1941, pp. 34–36.

DISCUSSION

Mr. L. D. Noble.[1]—What is the effect of repeatedly superheating magnesium? If one superheat refines the grain to a certain degree, will several superheats refine it to even greater a degree?

Mr. C. H. Mahoney.[2]—Generally speaking, each additional superheat produces additional refining, but the effect becomes small after the second treatment.

Mr. Noble.—Is it necessary to cast superheated magnesium back to pig to gain the maximum effect of refinement, or may the pot temperature simply be decreased to casting temperature and the mold then poured?

Mr. Mahoney.—No. The grain is fine when the casting is poured directly from superheating without pigging than when the superheated melt has been cast as pig and then remelted for recasting.

Mr. Noble.—What is the effect on grain size of repeated heatings to casting temperatures of superheated magnesium? Does the grain size remain constant, decrease, or increase?

Mr. Mahoney.—The grain size decreases slightly with each reheating and is influenced by the casting temperatures reached and by other factors.

Mr. Noble.—Is there a percentage of allowable foundry scrap below which the effect on grain size is negligible?

Mr. Mahoney.—We believe that the effect of scrap amounts on superheating results is progressive. With the percentage of scrap available in the ordinary foundry, the grain size is appreciably refined over that obtained with virgin metal alone, even though the latter has been super-

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[2] Chief Metallurgist, Metallurgical Dept., Basic Magnesium, Inc., Las Vegas, Nev.

heated. We prefer a minimum of 30 per cent scrap return to each melt.

Mr. Leslie W. Ball.[3]—On castings intended for high duty service, it is desirable to make a thorough study of the pilot parts. We have found that by cutting thin slices of metal from several sections of castings, we can obtain a great deal of information quickly and at small cost. X-ray diffraction methods can be used to determine grain size from these slices. The X-ray method is rapid and does not require the use of skilled operators.

Mr. Mahoney.—That probably is true, but the average foundry would feel that the expense of X-ray equipment was high, and someone would have to be thoroughly trained in its use, even if most of the work was done by semiskilled operators. The cost of ordinary metallurgical laboratory equipment is not high, and only a very few minutes are required to polish a magnesium sample.

Mr. Ball.—The expense of the X-ray method is quite small in view of the fact that the same slices provide much information about gas porosity and other microcavities as well as about grain size. In the radiographic study of slices, a whole series of them may be exposed at one time and examined on one film.

Mr. Mahoney (*author's closure, by letter*).—The number of interested comments which we have received in regard to this paper and the controversial discussions which it has apparently aroused have led us to the conclusion that some explanatory statements in regard to this paper and our reasons for its preparation could quite properly be attached to the paper itself.

This work on grain size standards was instigated through our need at Basic Magnesium, Inc., for a means of grain size classification which was adaptable to rapid laboratory analysis and capable of clear interpretation on the production floor.

Our initial measurements were made by the intercept method, but it was evident from the start that the characteristic structure of the cast magnesium alloys in the homogenized condition were excellently adapted to the utilization of the micro-comparison method. The grain outline of these structures was so similar to that of the austenitic network chart that we gradually abandoned preparation of comparison micrographs as representing unnecessary additional work and as offering no advantages in interpretative analysis for routine checks. We recognize that some instances demand closer than comparative estimate results, and under those circumstances we utilize the intercept method in our laboratory. We also recognize that no narrow system of standards can be evolved which will be entirely suitable for all circumstances unless it is readily adaptable to minor modification, subject to the alloy being examined and its condition, and it was for this reason that we assembled the chart showing the relationships between grains per unit of area and intercept values. It is readily conceivable that it will be desirable or even necessary to report some specimens in two or more grain sizes with the percentage of each, and that in the case of wrought specimens particularly it may be necessary to conceive of the grain count having been made on a three-dimensional system.

In view of the general interest in these proposed standards and the discussions which they have evoked, it might well be stated that the proposed numerical order of identifying the grain size was incidental to the main body of the work and was conceived of as applying to magnesium alone. Some thought was given to expressing the grain sizes in figures which represented the thousandths of inches which corresponded to the average intercept value. This conception was discarded, however, because of its limitations in adaptation to a universal system and because it was difficult to use in conjunction with the incremental steps which are a function of the austenitic system, and which we considered to be of considerable value from the standpoint of rational relationship between the various grain sizes. It was also difficult to use such a numerical order unless excessively large numbers were utilized or decimal figures resorted to.

The proposed system of grain size numbers is used at Basic Magnesium, Inc., in refinery production operation, where we find that the floor personnel are more easily made familiar with such a designation than would be possible when referring to grains per unit of area. It is readily conceivable that for technical and scientific uses a reference to the number of grains per unit of area would be more generally desirable, and we had no thought of losing the relationship between the number of grains per unit of area and numerical nomenclature. The numerical designations in the proposed system, in fact, are related mathematically to the number of grains per unit of area as can be seen by reference to this paper.

[3] Assistant Technical Director, Triplett & Barton, Inc., Burbank, Calif.

Testing Machine Industry

Statistics released early in the summer by the War Production Board contain some interesting information on the value of the output by certain industries, including precision, measuring, and testing machine and instrument groups. The statistics are grouped in five categories; in addition to testing machines and precision measuring devices, data cover gage blocks, micrometers, precision measuring tools (calipers, gages, indicators, etc.) and tool room specialties. Of this group, the precision measuring tools and testing machine and instrument field were about parallel as far as monthly shipments and backlog of unfilled orders were concerned. Shipments during each month from January, 1943, ranged from $2,150,000 to $2,700,000, with the unfilled orders at the end of the year totalling about $6,400,000. Total shipments for 1943 were valued at about $29,000,000, which figure indicates the importance of precision measuring and testing instruments. With the steadily increasing interest in evaluation of materials, the precision instrument field should continue to grow.

. . . "Human liberty depends not on charters and institutions alone. It depends on memory and the ancient heritage of men, on the voice of that humane confederation, scattered through many lands and through many ages, which it is the business of literature to make known. We have been progressively forgetting that heritage and trying to live as children without parents or teachers to guide them. In a recent statement of his faith in liberal education, Mr. Wendell Willkie, in an issue of *The American Scholar* puts the challenge squarely before us: 'When you range back and forth through the centuries, when you weigh the utterance of some great thinker or absorb the meaning of some great composition, in painting or music or poetry; when you live these things within yourself and measure yourself against them—only then do you become an initiate in the world of the free.' This is the true freedom we covet for our children here."—

An excerpt from a statement entitled "Literature in American Education," prepared for the Modern Language Association of America, and published in special pamphlet form by the Enoch Pratt Free Library of Baltimore, from which copies of the interesting report can be obtained without charge.

A Ball Impact Tester for Plastics

By Charles R. Stock[1]

SYNOPSIS

The recognized defects associated with impact strength tests of plastics where the testing machine has available much more energy than a required minimum to produce fracture, has resulted in efforts by various investigators to develop methods not subject to the sometimes large errors resulting from this condition.

This paper describes an apparatus which makes use of a set of steel balls of graded weights, from which may be selected one which, after gravitational acceleration down inclined rails, strikes a test specimen horizontally and utilizes all, or almost all of its kinetic energy in fracturing the specimen.

The construction, calibration, and operation of the apparatus is described, as well as the sources, reduction, and calculation of the magnitudes of several errors, both inherent and experimental.

Data are given for several types of thermosetting molded plastics, comparing results obtained by the present A.S.T.M. Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D 256 - 43 T)[2] (2 ft-lb. pendulum) as well as by the "Ski-Ball" method, pointing out discrepancies in magnitude of the values obtained. Other data illustrate the lower dispersion of results as well as the improved sensitivity obtainable with the latter method.

There are commercially available at the present time a number of materials, including several types of plastics, whose paramount physical characteristics whatever they may be, have been developed at some sacrifice of impact strength. Despite the subordination of this property in favor of other required attributes, the potential damage incurred in ordinary service and handling makes it obvious that any possible increase in impact strength is desirable.

Such materials as general purpose phenolics, ureas and melamine plastics, several of the electrical and heat-resistant plastic compounds and, in addition, some thermoplastics, ceramics, and glasses, possess impact strengths which are so low that the present A.S.T.M. Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D 256 - 43 T)[2] are not particularly satisfactory in revealing variations significant to service behavior. The principal reason for the lack of suitability of this method is the difficulty of obtaining or constructing a pendulum apparatus conforming to the requirements of velocity of impact (about 10 ft. per sec.) and having a capacity markedly lower than 2 ft-lb. striking energy. When a 2-ft-lb. machine is used to test such materials, the difference between the energy available and that absorbed in fracturing a notched Izod specimen is usually so great that the broken end is thrown off with some velocity. The energy associated with the flight of this piece cannot readily be separated from that required to produce fracture only, and the present widespread practice is to quote the total as the impact strength of the specimen. This error, which has already been recognized and discussed by Church and Daynes,[3] Callendar,[4] and Telfair and Nason,[5] is in some instances as much as 500 per cent greater than the energy required just to fracture the specimen. Moreover, it may introduce a haphazard variation in apparent impact strength which is not an inherent attribute of the specimens.

Two general approaches to the problem of measuring only the energy absorbed in fracturing a specimen have been followed. The first is exemplified by Hazen's interesting method[6] wherein he computes "toughness" from static flexural data. As pointed out by the author, this procedure yields values equivalent to impact data only for substances which break within the proportional limit; it could be extended to other materials if load-deflection data could be obtained at impact rates of straining. Similarly, a heavy pendulum would also be satisfactory if measurement of absorbed energy were made directly on the specimen rather than by the customary determination by difference.

In the above cases the testing machine has a large excess of energy available over that necessary to break the specimen. This condition may be described in terms of a constant, c, where in these instances $c \rightarrow 0$.

$$c = \frac{E_1 - E_2}{E_1} = \frac{\text{Energy removed from machine}}{\text{Energy capacity of machine}} \ldots (1)$$

E_2 is the residual mechanical energy in the machine after fracturing a specimen.

The second approach is that employed in the present work, and follows the philosophy of the investigators referred to above.[3,4,5] Here the attempt is to limit the energy available in the striker to the amount necessary just to fracture the specimen ($c \rightarrow 1$). The error introduced by including in the measurement the kinetic energy of the broken end will hence be minimized, since the piece will not be driven away, but will remain close to the point of impact. This "minimum energy" method has been applied in several ways. Church and Daynes and Callendar made use of a vertically falling weight which permitted adjustment to the desired energy either by keeping the weight constant and changing the impact velocity (changing the height of fall) or *vice versa;* their actual procedures favored maintaining a substantially constant velocity. Telfair and Nason used a standard pendulum with a minimum capacity (at 11 ft. per sec.)

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, 2, Pa.

[1] Physicist Stamford Research Laboratories, Physics Div., American Cyanamid Co., Stamford, Conn.

[2] 1943 Supplement to Book of A.S.T.M. Standards, Part III, p. 249.

[3] H. F. Church and H. A. Daynes, "The Falling Weight Impact Test for Ebonite," *Transactions*, Inst. of the Rubber Industry, Vol. 13, p. 96 (1937).

[4] L. H. Callendar, "New Methods for Mechanical Testing of Plastics," *British Plastics*, Vol. 13, Nos. 155, 156, April, May (1942).

[5] D. Telfair and H. K. Nason, "Impact Testing of Plastics—Energy Considerations," *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 1211 (1943).

[6] Thomas Hazen, "Toughness of Molding Materials," *Modern Plastics*, Vol. 21, October, 1943, p. 103.

of 2 ft-lb. and obtained lower energies by reducing the velocity of impact (reducing the height of fall).

Both systems yielded valuable information but the terms in which the results were quoted necessarily differed because of the different testing techniques employed. Because of the difficulty of measuring slight excesses of energy remaining after fracturing a specimen by means of a vertically falling weight, the investigators who used this machine could not easily give results in terms of energy absorbed in fracture under a single blow. Instead, two other methods were used. In one of these a specimen is repeatedly struck a blow of constant velocity but increasing energy until the specimen fractures; in the other a large number of specimens are tested in groups, each member of the group being struck only once, and each group being tested at a different energy level, but at constant velocity. The latter information is plotted in terms of the fraction of specimens of a group broken at each level of energy.

Neither of the above measuring techniques was felt to be entirely satisfactory for our purposes; the first because testing by repeated blows seemed to measure a factor more closely associated with endurance which, however valuable, should be considered separately; the second because the usual processes of testing for development and control cannot normally permit the expenditure of the specimens and time involved.

Although Telfair and Nason preferred, in using their pendulum apparatus, to obtain statistical data by a method similar to that of Church and Daynes, it is also possible with a pendulum to test each specimen directly under a single blow of minimum energy or, more strictly, a minimum excess of energy necessary to produce fracture, and then to subtract the excess recorded on the scale. Unfortunately, however, a pendulum with a rating of 2 ft-lb. at 11 ft. per sec. requires that the velocity be reduced to about 2 ft. per sec. to reach the minimum energy range for notched Izod specimens of some plastics. Such an excessive reduction in velocity raised some doubt as to the merits of results thus obtained, hence the construction of a lighter pendulum was considered, capable of delivering a blow of as little as 0.025 ft-lb., to which weights could be added to increase the capacity. Little reflection is required to realize that so light a structure is restricted, as a falling weight is not, by the dynamics which limit its details of design. Such a pendulum would have to weigh

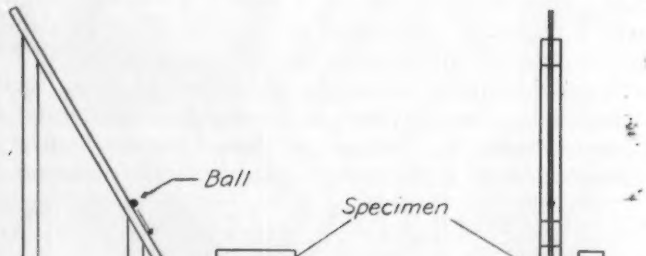

Fig. 1.—Apparatus for Striking an Impact Test Specimen with a Horizontally Travelling Ball.

about 6 g. and would require a length of something over 1 ft. in order to be accelerated gravitationally to a velocity of 10 to 11 ft. per sec. The greatest portion of the weight would have to be concentrated near the free end in order that the center of percussion coincide with the point of impact. This leaves, at most, about 1 g. for the weight of the supporting arm. These requirements make it obvious that the construction of such a pendulum is not practically feasible.

The Ball Impact Tester

Principles of Operation:

To approximate the action of a pendulum and gain the advantage of its simple means for measuring the excess of energy in terms of some characteristic of the controlled travel of the striker past the point of impact, while staying clear of the mechanical limitations just cited, use was made of a ball accelerated down an incline. Since the weight of the ball is concentrated around its axis of symmetry parallel to the direction of travel, it can be considered in effect a pendulum without an arm, supported from below rather than above.

If the ball, after acceleration to a desired velocity, is then redirected to follow a horizontal path, its free flight when leaving the end of the support will be parabolic and the shape of the parabola can be employed as a measure of the horizontal component of translational velocity and energy. This principle has long been applied for measuring the velocities of charged particles in electrostatic fields. Figure 1 is a diagrammatic sketch of a system of rails and supports by means of which a ball may be thus accelerated and directed. By measuring the height, y, of the end of the rails above the horizontal base, and by recording the horizontal distance of flight, x_1, of the ball, the horizontal translational velocity V_1 may be determined thus:

$$V_1 = x_1\sqrt{\frac{g}{2y}} \qquad (2)$$

If the weight of the ball is W, the horizontal component of the kinetic energy of translation may be determined from

$$E_1 = \frac{Wx_1^2}{4y} \qquad (3)$$

Hence, regardless of frictional forces between ball and rails, a set of balls whose weights progress in steps convenient for the purpose may be calibrated for any height of release in velocity and energy units.

Kinetics of Impact:

While the calculation, as described above, of the horizontal components of the velocity and energy of translation of a freely falling ball having no initial vertical velocity component is of fundamental simplicity, the establishment of means for the determination of losses from the mechanical system, during impact of the ball with a specimen held as a cantilever, becomes somewhat more involved. There are several reasons for this: namely,

1. During the period of contact between a ball and a specimen not only are translational effects to be accounted

for, but it must also be realized that the rotation of the ball may play a part, that is, an upward impulse may be imparted to the ball, resulting in an erroneous calculation of residual energy. This upward impulse must be proved to be negligible, must be made so by proper design, or must be taken into account. The desideratum is to keep translational and rotational effects separated and to measure only the former.

2. During contact, the deformation of a cantilever specimen will set up a component of the restoring force at right angles to the original direction of the ball, tending to change its line of flight through an angle away from the clamped end of the bar. Vertical clamping would obviously result in deflecting the ball out of a parabola from which its residual velocity could be correctly computed, hence the bar must be clamped horizontally. It remains to be demonstrated whether horizontal deflection of the direction of the ball introduces error.

3. For some plastics, particularly when tested as unnotched specimens, elastic storage of potential energy during deformation is released as kinetic energy upon rupture of the section, and the broken portion flies off despite the fact that all of the stored energy was necessary to fracture the piece. In this case it is a moot point as to what proportion of the kinetic energy of the broken end is to be regarded as excess, except in the occasional case where the striker is stopped at the point of impact, indicating a true condition of minimum energy.

4. In a method such as the one proposed here, that is, that of employing "minimum excess energy," the amount of excess in the case of the weakest specimen of a set is predicated upon the anticipated spread in strength from the weakest to the strongest specimen. This is a basic defect of impact testing under the condition that c is close to unity. Hence, if the strongest specimen to be broken is 20 per cent stronger than the weakest, the excess energy when testing the latter will likewise be at least 20 per cent. A partition of this residue will usually take place between the ball and the broken end of the specimen and the behavior of both must therefore be considered. (For the types of materials falling within the range covered by this apparatus the energy consumed in shear after fracture is initiated is small, hence the difference between complete breakage and just cracking will not be considered.)

Factors associated with problems 1, 2, and 4 are considered in more detail in the following paragraphs. The last two problems are encountered not only when testing by the presently described method, but also in any test where an excess of energy over the required minimum exists in the system and where the impact strength is obtained by difference.

(1) The possible importance of frictional forces caused by rotation of the ball against the specimen was discussed critically after the method had been presented before Subcommittee VIII on Research of A.S.T.M. Committee D-20 on Plastics. As a result the kinetics were analyzed mathematically by I. L. Hopkins[7] for the condition of horizontal impact. When modified to take account of

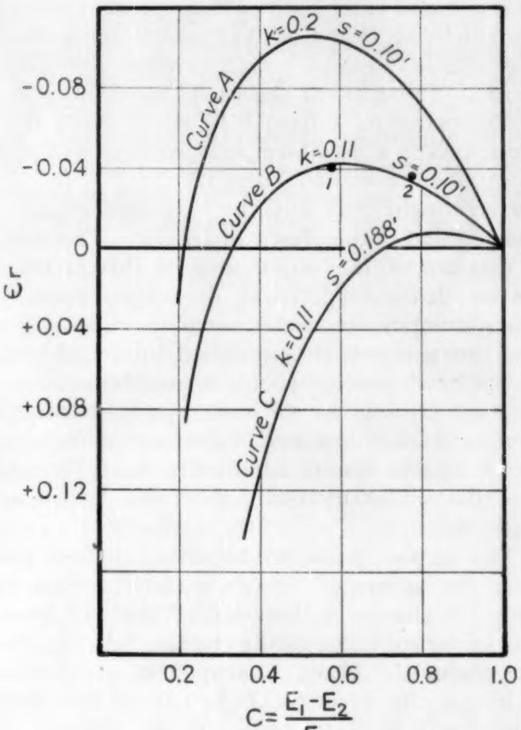

Fig. 2.—Relationship of Error Produced by Sliding Friction During Impact, to *C*, *K* and *S*.

the vertical component of velocity acquired by a ball in traversing the distance, $s-r$, this equation becomes:

$$\epsilon_r = \frac{1-c}{c}\left[\frac{\left[kV_1a - b + \sqrt{[b-kV_1a]^2 + d}\right]^2}{d} - 1\right] \quad (4)$$

where ϵ_r = fractional error, caused by rotation of the ball, in computing energy loss during impact,

k = coefficient of sliding friction,

$a = (1 - \sqrt{1-c})$,

$b = \frac{g}{V_1}(s-r)$, and

$d = 2gy$.

The magnitude of ϵ_r was determined, based on the known dimensions for the apparatus, of y = 0.737 ft. and s = 0.10 ft. and using a $^3/_4$-in. steel ball (r = 0.031 ft.). It was assumed that V_1 = 10.0 ft. per sec. and k = 0.20. Using these values in Eq. 4, it was possible to draw a curve (A, Fig. 2) relating ϵ_r to c. It can be seen that a maximum error of about 11 per cent in computing $(E_1 - E_2)$ will be obtained at c = about 0.55 and that the computed result would be low by the factor given by the curve, for any value of c above 0.21.

To determine experimentally the utility of Eq. 4 and the correctness of the assumptions used, high-speed motion picture photographs and simultaneous measurements of x_2 (See Fig. 1) were obtained for two tests wherein standard notched Izod specimens of a urea-formaldehyde composition were broken at two levels of c. When the actual initial velocities (9.6 and 9.7 ft. per sec., respectively) were corrected to the nominal figure of 10 ft. per sec. corresponding values of ϵ_r of − 0.041 and − 0.037 were obtained, as illustrated by points 1 and 2 of Fig. 2. Equa-

[7] Member Technical Staff, Bell Telephone Laboratories, Inc., New York, N. Y.

tion 4 was found to fit both of these points fairly closely for the condition that $k = 0.11$, indicating a maximum error of slightly over 4 per cent when $c =$ about 0.6 (curve *B*). The error in the useful range may be minimized by increasing s from 0.10 ft. to 0.188 ft. This change results in a maximum indicated error of less than 1 per cent above $c = 0.65$ (curve *C*).

It was thought that k might vary substantially with the composition of the plastic under test. Therefore, as a crude measure of the importance of this factor, three groups of identical specimens of a hard mineral-filled melamine composition were tested, coating the struck faces of one group with a polished surface of graphite, the second with a coating of a nitrocellulose household cement, and leaving the third untreated. No significant differences in measured test values could be detected. Although such a test is admittedly faulty it seems to indicate that, under the conditions of test, k does not vary seriously.

(2) The second point to be considered as possibly affecting the computed energy transfer during impact concerns the change in direction of the ball caused by bending of the specimen during the test. As the specimen deforms under the blow, a component of its restoring force changes the direction of the ball so that it flies at an angle away from the vise. If the integral of this force over its period of operation is entirely balanced by translational momentum of the ball, radial measurement of x_2 from its origin is justified, but if a change in the position of the axis of rotation indicates that angular momentum is contributing, radial measurement is in-

Fig. 3.—Ball Impact Tester.

The inclined rails of this laboratory constructed apparatus are of angle iron, while the curved end is galvanized sheet metal. The ball falls upon the carbon paper after breaking the specimen, producing a record from which its residual energy may be computed.

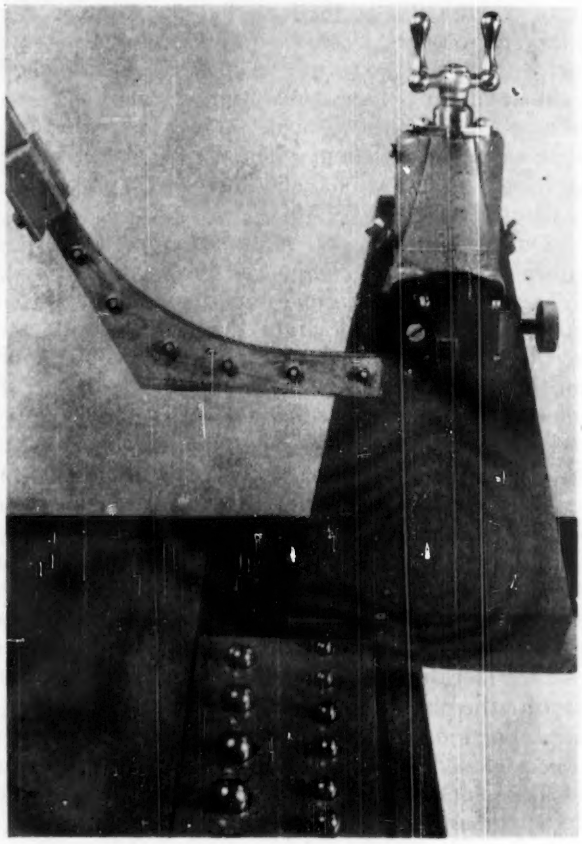

Fig. 4.—Details of Specimen Support and Vise.

The upright is of welded $^1/_2$-in. steel plate reinforced with webbing. By means of the cross-feed the vice and specimen may be adjusted to the correct height for a given diameter of ball.

correct. High-speed motion pictures of a marked ball revealed no departure of the axis of rotation from its original horizontal position normal to the translational axis. In most cases the difference occasioned by measuring the component of x_2 in the initial direction of flight is so small as hardly to warrant consideration.

(4) With the set of balls which have been chosen for use with this apparatus (Table I) it has so far been possible to select one which will break all the specimens of various sets of thermosetting materials with residual energy of 20 per cent or less. If it became necessary to test a material which exhibited a high degree of nonuniformity, it would not be possible to break all the specimens of a set and still maintain a lower limit of 0.80 for c. In this event the flight of the broken end of the specimen frequently indicates a sufficiently large dissipation of energy to warrant its being taken into account. A simple method for determining approximately the "broken half" energy is to apply the same procedure as for a ball of the same weight.

Construction and Calibration

An apparatus was built in the laboratory on an experimental basis following the general design shown in Fig. 1. The rails consist of 1 by 1-in. angle iron with the rolling edges milled in several stages and then honed by hand while clamped on a horizontal flat. In this way rolling surfaces were obtained which, to the best of our ability, were straight and smooth. The curved portion was made,

TABLE I.—HORIZONTAL VELOCITY AND TRANSLATIONAL KINETIC ENERGY OF STEEL BALLS ACCELERATED BY GRAVITY.

Averages of fifteen tests each. Dropping height 32.5 in.

Ball	Diameter, in.	Weight, lb.	Velocity, ft. per sec.	Energy, ft. lb.	Variation of Energy, v
No. 1	0.469	0.0151	10.4	0.0261	2.1
No. 2	0.484	0.0166	10.5	0.0298	2.1
No. 3	0.563	0.0261	10.6	0.0476	2.0
No. 4	0.594	0.0307	10.7	0.0558	1.7
No. 5	0.640	0.0385	10.7	0.0720	2.0
No. 6	0.703	0.0509	10.8	0.0957	2.0
No. 7	0.750	0.0620	10.9	0.1174	1.0
No. 8	0.796	0.0741	10.9	0.1429	1.0
No. 9	0.844	0.0881	11.0	0.1687	1.9
No. 10	0.906	0.1093	11.0	0.2107	1.3
No. 11	0.969	0.1335	11.1	0.2646	1.1
No. 12	1.000	0.1469	11.1	0.2889	1.2

by template and honing, from 0.070-in. sheet metal to give a radius of 6 in. with a tangent about 1 in. long, the latter to be the "jumping off place." The straight and curved sections were butted together and bolted so as to give as smooth a joint as possible and the two completed rails were fastened together with spacers of $^1/_4$-in. thickness separating them. The resulting assembly when erected on supports had an angle of incline of 60 deg. when the short tangent end of the curved section was horizontal. Undoubtedly machining facilities capable of turning out a "ski-jump" in one carefully finished piece would result in better precision of measurement than that shown in Table I.

The vise for clamping the specimen rigidly in position is mounted firmly on a cross-feed carriage from a bench lathe and this in turn is bolted to a heavy steel support made of $^1/_2$-in. plate reinforced with welded flanges in the rear. The resulting assembly is believed to be sufficiently stiff so that energy losses in vibration of the support may be neglected.

Twelve steel balls, comprising a set which vary in weight by convenient steps, covering a relative range of one to ten, were obtained from SKF Industries, Inc. These appear in Figs. 3 and 4, of which the former is a photograph of the apparatus mounted on a table top, showing the rails, the specimen vise, and support, and the surface upon which the ball records the distance of its free travel. The record is made by the ball when it strikes a sheet of paper over which has been placed a sheet of typewriter carbon paper.

In the close-up (Fig. 4), the bar is shown clamped 1.2-in. from the end of the rails. (This was subsequently changed to 2.25 in. in accordance with curve C of Fig. 2.) A ball leaving the rails strikes the specimen 0.865 ± 0.005 in. from the vise and can be made to strike half way between the top and bottom edges, regardless of the ball's diameter, by moving the cross-feed up or down. When positioned accurately with the struck face of the specimen vertical, a ball which does not break a stiff, elastic material will rebound and roll back up the rails a short distance provided the test bar is not more than 2 in. from the rails. In cases where the specimen cracks or breaks, the ball drops through the vertical distance y and strikes the recording surface.

The set of balls was calibrated with regard to horizontal translational velocity and energy by means of Eqs. 2 and 3, recording x_1 for 15 determinations on each ball. The average velocity and energy and the coefficient of variation[8] of energy were computed. Table I lists the diameters and weights of the balls and their calibration for a height of release of 32.5 in. The velocity is not uniform for all balls but tends to increase with the weight, probably reflecting the decreasing influence of friction. Figure 5 illustrates graphically the patterns obtained in calibrating the ball showing the most, and the ball showing the least deviation from the mean. The end of the rails is vertically over the center of curvature of the reference arcs.

[8] The coefficient of variation (v) measures the relative dispersion of a set of values. It is the ratio of the standard deviation to the average, expressed as a percentage.

Calculations

The horizontal component of energy of translation lost by the ball in striking a specimen is the difference between the original energy content E_1, for which the ball has already been calibrated, and its residual energy E_2. Provided that all unwanted effects have been minimized and the test conditions are fixed, E_2 may be related only to x_2 and the residual energy may be obtained directly.

It may be shown that the residual horizontal component of velocity of the ball is determined by

$$V_2 = \frac{x_2 + r}{\sqrt{\frac{2y}{g}} - \frac{(s - r)}{V_1}} \qquad (5)$$

(x_1 and x_2 are measured by the record made by a ball in striking upon a sheet of carbon paper placed on the horizontal base. x_1 is measured from a point vertically under the end of the rails to the spot made by a ball in free flight; x_2 is the distance from an origin vertically beneath

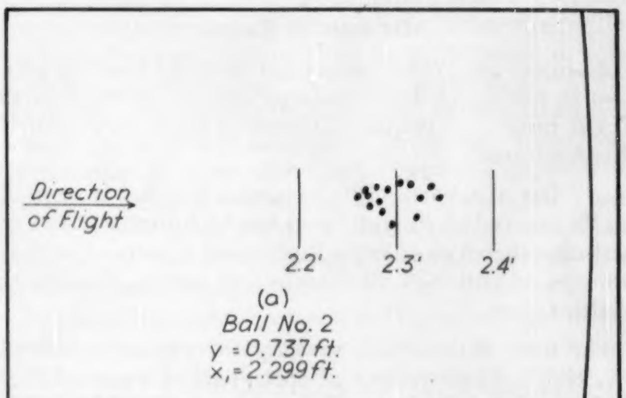

Fig. 5.—Typical Calibration Records for E_1.

The two records illustrate the largest and smallest deviation patterns obtained in calibrating the set of balls.

the point of impact with a specimen, to the subsequent spot record.) If the residual and original energy for any ball is expressed in general terms as a ratio of the equivalent kinetic energy equations weight is eliminated and V_2 and V_1 may be given in terms of Eqs. 5 and 2, respectively. This results in expressing E_2 of any ball as a fraction of its E_1 in terms of x_2 thus:

$$\frac{E_2}{E_1} = \left[\frac{x_2 + r}{x_1 - s + r}\right]^2 \ldots\ldots\ldots\ldots\ldots (6)$$

from which

$$c = 1 - \left[\frac{x_2 + r}{x_1 - s + r}\right]^2 \ldots\ldots\ldots\ldots (7)$$

and cE_1 measures the loss in energy experienced by the ball.

A radial chart or a rotatable scale marked off in c according to Eq. 7 may now be placed on the base with its center at the origin of x_2 and will serve to indicate rapidly the energy lost by any ball. Variations in V_1 (Table I) are sufficiently small that, using an average x_1 for the set, c for the most widely divergent ball is in error by 0.02 or less, down to $c = 0.7$.

In view of the fact that any excess of energy also imparts some velocity to the broken end of the specimen, cE_1 will give too high a figure if taken as a measure of impact strength. However, the energy of the broken end may be computed by means of its weight and the point at which it strikes the base. Rotational energy of the end of the specimen, even when c is small and a dense substance is tested, is extremely low and may be ignored.

Mechanical Errors

As in any test, errors associated with the limiting precision in setting up the apparatus will affect the accuracy of the results. Two such sources of error are evident in this apparatus:

(*a*) The struck face of the specimen may not be vertical,

(*b*) The end of the rails may not be horizontal and the ball may therefore start its flight with a vertical velocity component although all calculations assume the absence of this factor.

The first of these was investigated experimentally by breaking a large number of specimens of a material exhibiting rather uniform impact strength. These were tested in three groups, one set being tested at —5 deg., one at +5 deg., and the third at the vertical. A ball was used which made c approximately 0.9. Under these conditions c (as computed from x_2) demonstrated an apparent variation of 0.005 per degree. It is not difficult to align the clamp so that the struck face of the specimen is vertical within less than 1/2 deg.

The second error was found to be calculable from

$$\epsilon_\theta = \frac{x_1}{y} \tan\theta \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

where ϵ_θ is the fractional error in E_1 and θ is the angle of inclination. For this apparatus, therefore, ϵ_θ is about 5 per cent per degree. By using one of the balls on the rails as a criterion of levelness it has been possible to stay within $\pm$1/2 deg.; the corresponding error would therefore be less than $\pm$ 2.5 per cent. Analysis by high-speed photography of a free flight in which x_1 was measured showed that E_1, as determined both ways, differed by 1 per cent.

Test Results

In Table II are listed several plastic molding compounds which have been tested as notched Izod specimens both in the present apparatus and in a pendulum machine of 2 ft-lb. energy rating. It is obvious that the large discrepancy apparent for the weaker materials has almost disappeared for the strongest (cloth-filled) plastic.

TABLE II.—COMPARISON OF RESULTS—PENDULUM *VERSUS* BALL IMPACT TEST.

Material[a]	Impact Strength, ft-lb. per in. of notch	
	Pendulum	Ball
A	0.40	0.057
B	0.42	0.190
C	0.37	0.290
D	0.59	0.54

[a] Melamine resin, various fillers.

The dispersion of individual tests around the average was also found to be sufficiently small for some types of compounds to warrant testing only three specimens. Typical results are given in Table III. This is in contrast to the relatively wide scatter observed when testing plastics of low impact strength in a pendulum machine, regardless of inherent uniformity.

TABLE III.—TEST RESULTS.

Ball impact tester. Notched Izod specimen, 0.865 in. cantilever. Mineral filled Melmac.

Test	Conditioning	Impact Strength, ft-lb. per in.	Conditioning	Impact Strength, ft-lb. per in.
No. 1	60 days at room	0.277	Additional 7	0.317
No. 2	temperature	0.299	days at 85 F.	0.324
No. 3	and 20 to 25	0.296	and 90 per	0.319
No. 4	per cent rela-	0.302	cent relative	0.332
No. 5	tive humidity	0.275	humidity	0.319
Avg.		0.290		0.322

The sensitivity obtainable by means of the ball impact test is also illustrated in Table III where the effect of conditioning is readily apparent. Such sensitivity should also be advantageous in examining the effect on impact strength of cure, notching, and changes in formulation.

Conclusions

Despite the practical and theoretical shortcomings of the ball impact tester which have been pointed out in the foregoing description, it is nevertheless sufficiently superior to the pendulum type of tester, from the standpoint of increased significance of results, and to falling weight testers because of the saving in time and specimens, that our present apparatus has been kept in frequent use on materials of low impact strength. By making use of the method outlined it should easily be possible to check Callendar's findings regarding the effect of specimen and notch dimensions on impact strength. It is contemplated that an investigation of this nature may shortly be undertaken.

Acknowledgments:

The assistance and helpful criticism given by the members of Subcommittee VIII, as well as by Messrs. L. Boor and D. McLachlan, Jr., of the Stamford Laboratories, is gratefully acknowledged. Thanks are also extended to the Directors of the Stamford Laboratories for their permission to publish this paper.

A Survey of Gum Residue Test Methods for Fuel-Resistant Synthetic Rubber Materials[1]

By Jules I. Wittebort[2]

The purpose of this paper is to review the various test methods employed in Army Air Forces specifications for determining the characteristics of the gum residues extracted from various synthetic rubber materials by aircraft fuels.

As a group we are interested in obtaining the best possible performance from the individual rubber products for the airplane and its accessories. However, we must be primarily interested in the over-all performance of the airplane else our individual efforts are in vain. For this reason we must investigate the effects of synthetic rubber materials on aircraft fuels as well as the effect of the fuel on the synthetic rubber.

As far as is known there are very few published data available on the effects of various types of fuel contaminations on the operation of aircraft engines, and for this reason it has been necessary to draw upon operational experience to point to suitable materials.

In the early efforts to analyze the gum contaminations contributed by various synthetic rubber-lined fuel containers and fuel conveyors, it was found that a modification of the A.S.T.M. acetone extraction method,[3] coupled with the copper dish gum residue test for fuels,[4] was suitable for determining the total amount of extractible materials.

The following procedure has been recommended:

A 5-g. sample of the synthetic rubber material is diced into $^1/_{16}$-in. cubes, weighed to nearest 0.001 g., placed in a Sohxlet extractor or similar extraction apparatus, and extracted for 24 hr. with 150 ml. of boiling A.S.T.M. precipitation naphtha,[5] in much the same manner as acetone extractions are carried out. Portions of the extraction fluid are then poured into a brightly polished copper dish, recently weighed, and placed over an open steam bath until the total amount of extraction medium is evaporated, as indicated by the absence of the odor of naphtha. The copper dish and contents are then removed from the steam bath, dried in an oven maintained at 212 to 220 F. for 30 min., cooled to a room temperature in a desiccator, and finally weighed. The increase in the weight of the copper dish times 100, divided by the weight of the original sample, gives the percentage of extractible materials contained in the synthetic rubber sample. This value has been found to agree closely with values calculated from available compounding data.

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

[1] Presented at a meeting of Subcommittee XIX on Immersion Tests of Committee D-11 on Rubber Products, June 26, 1944.

[2] Materiels Engineer, Air Technical Service Command, Wright Field, Dayton, Ohio.

[3] Tentative Methods of Chemical Analysis of Rubber Products (D 297 – 43 T), 1943 Supplement to Book of A.S.T.M. Standards, Part III, p. 369.

[4] Tentative Specifications for Aviation Gasolines (D 615 – 41 T), 1942 Book of A.S.T.M. Standards, Part III, p. 890.

[5] Standard Method of Test for Precipitation Number of Lubricating Oils (D 91 – 40), 1942 Book of A.S.T.M. Standards, Part III, p. 196 and Tentative Method of Test for Haze of Transparent Plastics by Photoelectric Cell (D 672 – 42 T), *Ibid.*, p. 1260.

By extending the extraction time to 48 hr. and using 250 ml. of 40 per cent aromatic fuel, containing 5 per cent benzene, 15 per cent xylene, 20 per cent toluene, and 60 per cent grade 62 engine fuel by volume, in place of A.S.T.M. naphtha, it is possible to obtain complete extraction at room temperature, thus greatly simplifying the extraction procedure. In places where corrosive atmospheres are experienced, a glass dish may be used in place of the copper dish. A copper strip may be suspended in the fluid for checking the corrosion properties of the contaminated fuel.

The accuracy of this determination is dependent upon several factors. First and foremost is the rate of extraction which in turn is dependent upon the aromaticity of the fuel used, the permeability characteristics of the synthetic being extracted, as well as the temperature at which the extractions are carried out. These factors can generally be eliminated by continuing the extraction for 48 hr. at room temperature and using 40 per cent aromatic fuel as the extracting medium. Another factor affecting the final results is variations in the rate of air flow over the copper dish, which in turn influences the evaporation of extracting fluid. This factor is difficult to control unless a special costly steam bath is constructed. Another factor is the boiling range of extracting medium. Unless this fluid has its maximum boiling temperature below the boiling range of the extractible residues being determined, some of the residue will be lost. A.S.T.M. naphtha, P.P.F. 813, and the newly developed SR-6 standard immersion medium seem to be generally satisfactory from this standpoint. An accuracy of 5 per cent can be expected by a careful operator who is cognizant of the details associated with this method. Tests are usually run in duplicate, along with a blank test, to determine the gum level already present in the extraction medium.

An idea of the corrosive nature of the extractible residue can be gained by observing the color of the copper dish. A dark brown to black corrosion indicates the presence of abnormal amounts of free sulfur or other corrosive substances in the synthetic rubber material.

An additional procedure was added to the above method to determine the resolubility characteristics of the copper-dish residue which involved the washing of the copper dish residue with ten 50-ml. portions of 40 per cent aromatic fuel within 1 hr., and filtering these washings through a weighed Gooch crucible. The combined increase of the Gooch crucible and the copper dish is considered the fuel-insoluble residue. This was an effective method for eliminating materials having varnish-like residues formed by low-temperature polymerization.

Other modifications of the copper-dish method have been applied or proposed for Army Air Forces specifications which involve the determination of the gum level of samples of contaminated fuel taken from production tanks and hose. These methods have proved to be none too satisfactory because of widely varying fuel to area ratios found in various shapes of containers and conveyors which

necessarily affect the gum residue levels in the extracting fuels. The methods, however, have a practical note and can be used to an advantage in certain development work.

Because of the requirements for greater low temperature and aromatic resistance imposed by the armed services, the various rubber manufacturers found it necessary to use greater amounts of plasticizers to secure suitable low-temperature performance with the higher acrylonitrile synthetics. This, of course, called for a revision of certain specification requirements as well as the development of new methods for determining the suitability of the new low-temperature plasticizers appearing in aircraft fuels. Operational experience has pointed to the need of these unavoidable extractible materials being volatile and inflammable, thus causing the least trouble in their passage through the carburetor, manifold, and combustion chambers.

In a search for a rapid and accurate method for determining the volatility of these fuel-extractible gum residues, it was found that the A.S.T.M. air-jet method[6] offered a logical answer to our problem. This method involves the rapid evaporation of fuels under controlled temperature and air velocity conditions.

The following procedure is recommended:

A 5-g. sample of the fuel-resistant synthetic is diced up in $^1/_{16}$-in. cubes and placed in a flask containing 250 ml. of 40 per cent aromatic fuel and allowed to extract for 48 hr. at 77 ± 5 F. The contaminated fuel shall then be decanted off and the gum residue determined on the A.S.T.M. air-jet apparatus. A 50-ml. portion of the contaminated fuel is carefully pipetted into a 100-ml. Berzelius type beaker which is then placed in a heated cavity maintained by a Prestone-water mixture boiling at 305 to 320 F. and evaporated for 45 min. under a controlled air jet delivering preheated air at a rate of 1 liter per second into the center of the beaker. The gum residue can be calculated as the percentage of the original sample weight, or as milligrams of residue per 100 ml. of contaminated fuel. A blank run is made simultaneously in order to make the necessary corrections for preformed gums already appearing in the test fuel. The evaporation time was set at 45 min. in order to give the most reproducible data and best measure the volatility of the various fuel-extractible residues.

It has been found that residues of the dibutyl-phthalate or dibutyl-sebacate type are almost entirely volatilized at the end of the 45-min. period while varnish-like residues remain almost undiminished under similar treatment thus distinguishing the various stocks that might cause resinous deposits in carburetors, manifolds, and the valve guides in aircraft engines.

It has been found that this new method is more reproducible due to better control of the evaporation conditions than the copper-dish method. Since less time is required to accomplish the air-jet tests, this method becomes especially attractive for production testing of synthetic rubber materials.

A "stoving" test has been developed by the Naval Research Laboratory whereby a beaker containing the air-jet residue is heated for 30 min. in a suitable bath maintained at 575 ± 9 F. and afterwards cooled and reweighed. The increased weight of the beaker is considered as the "stoved residue" in milligrams per 100 ml. of contaminated fuel. This value is considered indicative of the nature of the gum residue in that varnish-like residues or lower polymers of the synthetic rubber tend to remain while volatile or combustible residues have almost entirely disappeared from the test beaker.

Summary

Where data on the total amount of extractible residue and the corrosion properties of fuel resistant synthetics are desired, a 48-hr. room temperature extraction procedure in which the contaminated fuel is analyzed by the copper-dish gum residue procedure is considered convenient and useful.

Where a knowledge of the extractible residues is desired, the A.S.T.M. air-jet method coupled with the Navy "stoving test" provides a suitable means of measuring the relative volatility and the combustion characteristics of gum residues extracted from fuel-resistant synthetics.

[6] Standard Method of Test for Gum Content of Gasoline (D 381 – 42), 1942 Book of A.S.T.M. Standards, Part III, p. 186.

Shot Peening and the Fatigue of Metals

Growing applications of shot peening, a process used to give increased properties, particularly longer endurance, to materials have aroused much interest in this process. Just published by the American Foundry Equipment Co. is a report on "Shot Peening and the Fatigue of Metals" by Prof. H. F. Moore. In addition to a detailed evaluation of the process, technique, etc., there is a glossary of technical terms and a list of references. Copies of the 24-page report can be obtained from the company in Mishawaka, Ind.

Welded Ship Data

The September *Welding Journal* of the American Welding Society has some interesting material on failure of certain welded merchant vessels, including a condensed report on structural reinforcement of Liberty ships with detailed specification suggestions, an interim report signed by Admirals Johnson, Cochrane, Vickery, and Mr. Arnott on the methods of construction of vessels with interesting information on hull fractures. Also there are illustrations of ships showing the failures, and copies of the original reports, of six vessels which suffered complete breaks.

The Young Engineers' Obligations

"Never before has there been so pressing a need for clear thinking and broad vision that can evaluate correctly the long-term consequences of different policies and courses of action. This applies to every front: business, labor, and government. Integrity in thinking, knowledge that facts—all the facts—and not wishes underlie sound decisions: these characterize the engineer and are the secret of his success in transforming the material world.

"One of the first and most important lessons the engineer learns is that his efforts as an individual are very limited. Only by working in concert with others may his contribution result in great accomplishment. Never has this been so exemplified as in the past three years of war. The miracles of development and production have been made possible only by cooperative research and the pooling of knowledge and experience. Led for the most part by national professional societies, standardization and cooperative effort have made the greatest advances ever witnessed in a similar period. Through a professional society does an engineer find fullest opportunities for effective work, and for self-development and expression? Merely joining such an organization means little, but by active participation in the society's work, by assisting in molding its aims and policies, the young engineer can lift himself beyond the routine of today's work and with his fellows take a major part in shaping the better world of tomorrow."—Excerpts from a guest editorial by Donald W. Douglas, Douglas Aircraft Co., Inc., published in the August issue of *Aeronautical Engineering Review*.

Tests for Abrasion, Adhesion, Flexibility, and Hardness of Traffic Paints

Progress Report of Group 2 of Subcommittee IV on Traffic Paint of A.S.T.M. Committee D-1 on Paint, Varnish, Lacquer, and Related Products

Prepared By Charles W. Allen[1]

Subcommittee IV on Traffic Paint of Committee D-1 met for the first time in March, 1942. At that time Chairman Skett appointed a group to study tests for abrasion, adhesion, flexibility, and hardness of traffic paint. The purpose of this study is to determine, if possible, the value of these tests in estimating the behavior of traffic paint in service and possibly to recommend to the Society methods of tests that proved to be of value. The work of this group to date is presented herewith purely as a progress report, and until further information can be gathered, the group cannot recommend any method of test described in this report. Cooperators in this work are:

- H. W. Leavitt, Main State Highway Commission.
- K. B. Woods, Joint Highway Research Project, Purdue University.
- Sid Werthan, Research Division, New Jersey Zinc Co.
- E. F. Hickson, National Bureau of Standards.
- J. E. Myers, Division of Engineering, State of New York Department of Public Works.
- M. S. Herbert followed by D. H. Dawson, E. I. Du Pont de Nemours and Co., Inc.
- Charles W. Allen, Bureau of Tests, Ohio State Highway Department.

In June, 1942, eight samples of traffic paint from eight different producers were distributed to each member of group 2 for testing. The paints were also included in the 1942 Ohio field service tests on portland-cement concrete, bituminous concrete, and brick pavement surfaces. These paints were widely different in both pigment and vehicle composition and considerable difference in service was anticipated.

No attempt was made to standardize the procedure that should be followed in each type of test and each cooperator was at liberty to choose the method of test that he felt would give best results.

The Ohio field service test consisted of applying the paints on the three types of pavement surfaces in diagonal lines 12 in. in width, running from the center line of the pavement to the edge, and examining and rating the lines at regular intervals over a period of several months. The pavement widths were 20 ft. and the traffic count for each pavement was approximately 3000 vehicles per 24 hr. Figure 1 is a general view of a test section. Figure 2 shows the condition of the test lines after 5 months' service.

Table I shows the film failure rating of each paint at monthly intervals for 6 months. It will be noted that the relative order of durability changes very little after the third month exposure.

Tables II, III, and IV summarize the cooperators' tests for hardness, adhesion, and flexibility characteristics of the paints, respectively.

Table V summarizes the cooperators' tests for abrasion and compares the cooperators' rating with the field service rating at the end of 6 months. Mr. Hickson's abrasion results are shown graphically in Fig. 3.

The results of these tests were discussed by the group at the time of the June, 1943 Annual Meeting and it was the opinion of those present that no correlation could be drawn between the hardness, adhesion, and flexibility tests investigated and abrasion tests or field service tests. Close correlation was found between the abrasion results of two cooperators and the field service tests and fair correlation between several others.

It was decided to ask Messrs. Leavitt, Hickson, and Werthan to run abrasion tests on six additional samples which had been included in the 1943 Ohio field service tests. These samples, designated as 1A to 6A, inclusive, were chosen to represent a rather wide range of durability,

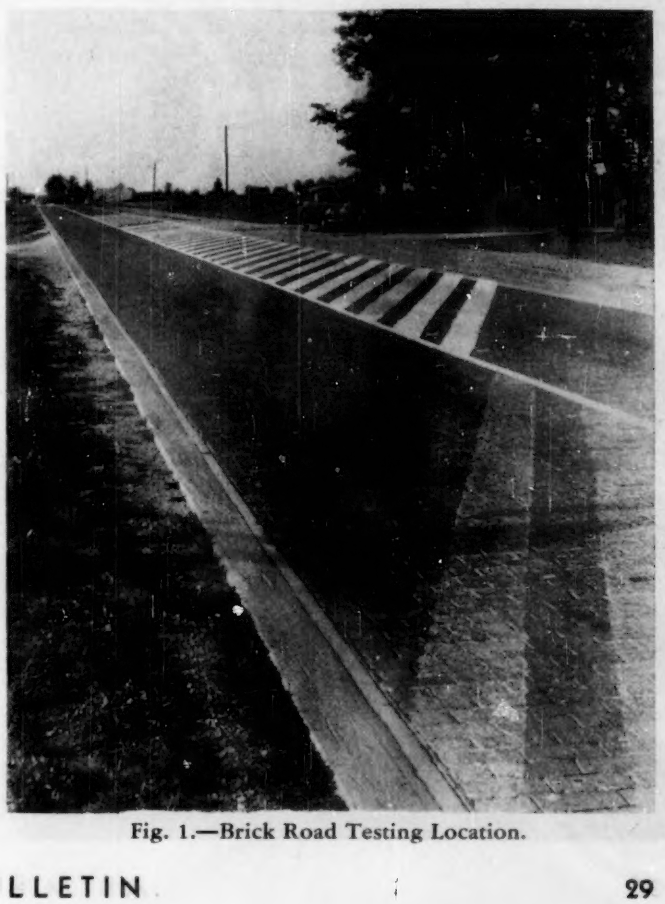

Fig. 1.—Brick Road Testing Location.

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Bituminous Concrete Pavement

Portland Cement Concrete Pavement

Brick Pavement

Bituminous Concrete Pavement

Portland Cement Concrete Pavement

Brick Pavement

Fig. 2.—Ohio Service Test—Five Months' Exposure.

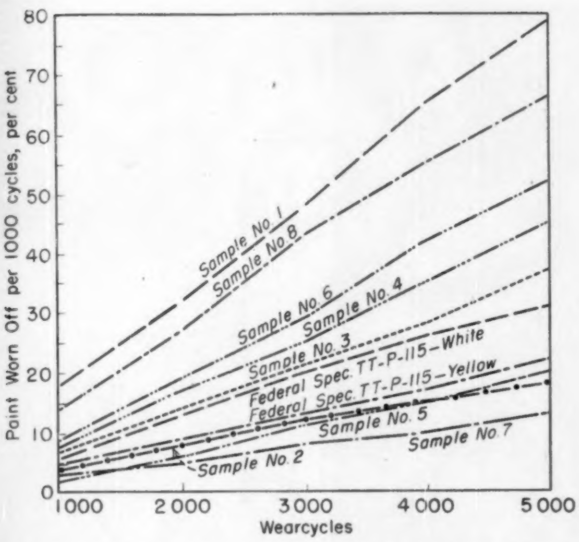


Fig. 3.—Results of Taber Abraser Tests (C810 Wheels).

as shown in the field service tests, and were submitted to these group members in September, 1943. Pictures of the test lines after 4 months' service are shown in Fig. 4.

The results of the first tests on this set of samples reported by Mr. Hickson are shown graphically in Fig. 5. The test procedure was identical with that followed by this cooperator in testing the first series of samples. In comparing these results with field service film failure results good agreement was found with the exception that the abrasion test showed sample 3A worst whereas the field service test rated it third.

A second series of tests was run by Mr. Hickson using the following procedure: The paints were applied (0.01 in. drawdown wet films) to Taber Abraser steel panels and allowed to air-dry 48 hr. The panels were then exposed for 168 hr. in an Eveready X-1a accelerated weathering machine as described in Federal Specification on Paint, Varnish, Lacquer, and Related Materials; general specifications (methods for sampling and testing) (TT-P-141a). After weathering the panels were subjected to the Taber Abraser test using CS 15 wheels and 1000-g. load. The abrasion was continued through 2000 wear cycles.

Mr. Hickson also applied the six paints to a service test on Connecticut Ave., Washington, D. C., just north of the National Bureau of Standards on November 19, 1943. The surface of this pavement is sheet asphalt. The paints were applied perpendicular to traffic at a spreading rate of 20 gal. per mile (6-in. stripe). The lines were rated after 6 months' service.

Mr. Leavitt again used the abrasion machine developed by him and which is described in *Maine Technology Experiment Station Paper No. 19*. However, in this series of tests, in addition to the dry method, a wet method was used in which water was allowed to drip on the revolving paint wheel surface. Each paint was applied in three different positions on the wheel by means of a doctor blade producing a film thickness of 0.005 in. Duration of the dry abrasion was 235,140 revolutions and duration of the wet abrasion was 156,547 revolutions.

Mr. Werthan in testing this series of paints used the following procedure: The paints were applied at a wet film thickness of 0.004 in. to level 10 by 10-in. tin plate panels which had been roughened with steel wool. The paints were allowed to dry for 48 hr. under standardized conditions and then exposed to the New Jersey Zinc Co. standard accelerated weathering cycle for two 6-day weeks. The cycle includes in various sequences exposure to light under dry and humid conditions, to a fine water spray, and to refrigeration. A week's exposure consists of a total of $111^1/_2$ hr. of light, 12 hr. of water, $12^1/_2$ hr. of refrigeration, and 3 hr. for changes and inspection. The weathered panels on removal from the units are saturated with moisture by keeping them wrapped in wet towels for 18 hr. after which abrasion resistance is determined using the New Jersey Zinc Co. abrasion tester. This abrasion tester is described in the *Official Digest*, Federation of Paint and Varnish Clubs, February, 1942.

Table VI compares results obtained by cooperators on this set of traffic paint samples.

Figure 6 shows photographs of the Taber Abraser panels that were run after accelerated weathering. Mr. Hickson comments concerning the panels as follows:

"You will note that a visual rating of the worn areas does not necessarily parallel the quantitative results. You will note panels 2A and 5A show checking. All panels show some chalking with 4A being very heavy (worst) and 3A next. Panel 3A shows a few microscopic cracks. Panels 1A and 6A show the best weathering with only very slight chalking."

Table VII gives the detailed results of Mr. Werthan's tests.

The comparison of results shows identical ratings by Mr. Hickson's accelerated weathering Taber Abraser method, Mr. Leavitt's dry abrasion method, and Mr. Werthan's accelerated weathering-abrasion method, and also excellent correlation between the results of these three methods and the field service ratings for this series of samples.

The comparison of the Connecticut Ave. and Ohio field service ratings are of particular interest since the Connecticut Ave. lines were applied November 19, 1943, whereas the Ohio lines were applied July 1, 1943. The Connecticut Ave. lines were therefore rated after essentially winter service and the Ohio lines after summer service.

Mr. Leavitt's and Mr. Werthan's results were not available at a meeting held in February, 1944, at which the members of the group present considered the results of Mr. Hickson's tests and the past work of the committee. From the results reported at that time it appeared that whereas Taber Abraser results on unweathered panels did not show good correlation with field service tests, 2 weeks' outdoor weathering before abrasion improved the correlation and accelerated weathering before abrasion gave excellent correlation with the samples examined. It was decided therefore, that six additional samples of traffic paint should be distributed to the group members and that those who had the equipment should test them in accordance with Mr. Hickson's method while other members should investigate the combination of accelerated weathering and abrasion with equipment available to them. These samples have been distributed and will be included in the Ohio 1944 field service tests.

After receiving Mr. Leavitt's results which show by his dry abrasion method the same rating values as obtained by

Fig. 2.—Ohio Service Test—Five Months' Exposure.

TABLE I.—FIELD SERVICE FILM FAILURE RATINGS.

Date Applied: 6-3-42

Sample	1 Month Exposure: Film Failure Rating[a] Concrete	Brick	Bituminous Concrete	Avg.	Relative Order of Durability	2 Months Exposure: Film Failure Rating[a] Concrete	Brick	Bituminous Concrete	Avg.	Relative Order of Durability	3 Months Exposure: Film Failure Rating[a] Concrete	Brick	Bituminous Concrete	Avg.	Relative Order of Durability	4 Months Exposure: Film Failure Rating[a] Concrete	Brick	Bituminous Concrete	Avg.	Relative Order of Durability	5 Months Exposure: Film Failure Rating[a] Concrete	Brick	Bituminous Concrete	Avg.	Relative Order of Durability	6 Months Exposure: Film Failure Rating[a] Concrete	Brick	Bituminous Concrete	Avg.	Relative Order of Durability	Grand Average Film Failure Rating[a]	Average Relative Order of Durability
No. 1......	8	9	8.5	8.5	7th	5	6	6	5.7	7th	5	6	5	5.3	7th	3	4	5	4.0	8th	2	2.5	4	2.8	8th	0	1	2	1.0	8th	4.6	8th
No. 2......	10	9	9	9.3	4th	9	8	9	8.7	1st	8.5	8	8	8.2	1st	8	7	8.5	7.8	1st	7.5	6	7.5	7.0	1st	6.5	6	7	6.5	1st	7.9	1st
No. 3......	10	9	10	9.7	2nd	8	8	8.5	8.2	3rd	7	8	7.5	7.5	3rd	6	7	8	7.0	3rd	6	6	6	6.0	3rd	5—	5	5	5.0	3rd	7.2	3rd
No. 4......	10	9.5	10	9.8	1st	8	8	8.5	8.2	3rd	6	7	6	6.3	5th	5	6	7	6.0	5th	5	5	5	5.0	6th	2	3	3	2.7	6th	6.3	5th
No. 5......	9	10	10	9.7	2nd	7	7.5	8	7.5	5th	6.5	7.5	7	7.0	4th	6	6.5	6.5	6.3	4th	6	6	6	6.0	3rd	4	5	4.5	4.5	4th	6.8	4th
No. 6......	9	8	8	8.3	8th	8	6	6	6.7	6th	7.5	5	6	6.2	6th	6	5	6	5.7	6th	6	5	6	5.7	5th	5	2	4	3.7	5th	6.1	6th
No. 7......	10	8.8	8	8.9	6th	9	7.8	8	8.3	2nd	9	7	7.3	7.8	2nd	9	7	7.5	7.8	1st	8	6	6.5	6.8	2nd	6	4	6.5	5.5	2nd	7.5	2nd
No. 8......	9	9	9	9.0	5th	6	4	7	5.7	7th	5	3	6	4.7	8th	4	4	6	4.7	7th	3	2	5	3.3	7th	1	2	3	2.0	7th	4.9	7th

[a] Film Failure rated according to Ohio State Highway Supplemental Specification No. M-109.16(c) as follows:
10—Perfect or absence of failure.
9, 8, 7—Good or slight failure.
6, 5, 4—Fair or intermediate failure.
3, 2, 1—Poor or bad failure.
0—Very poor or complete failure.

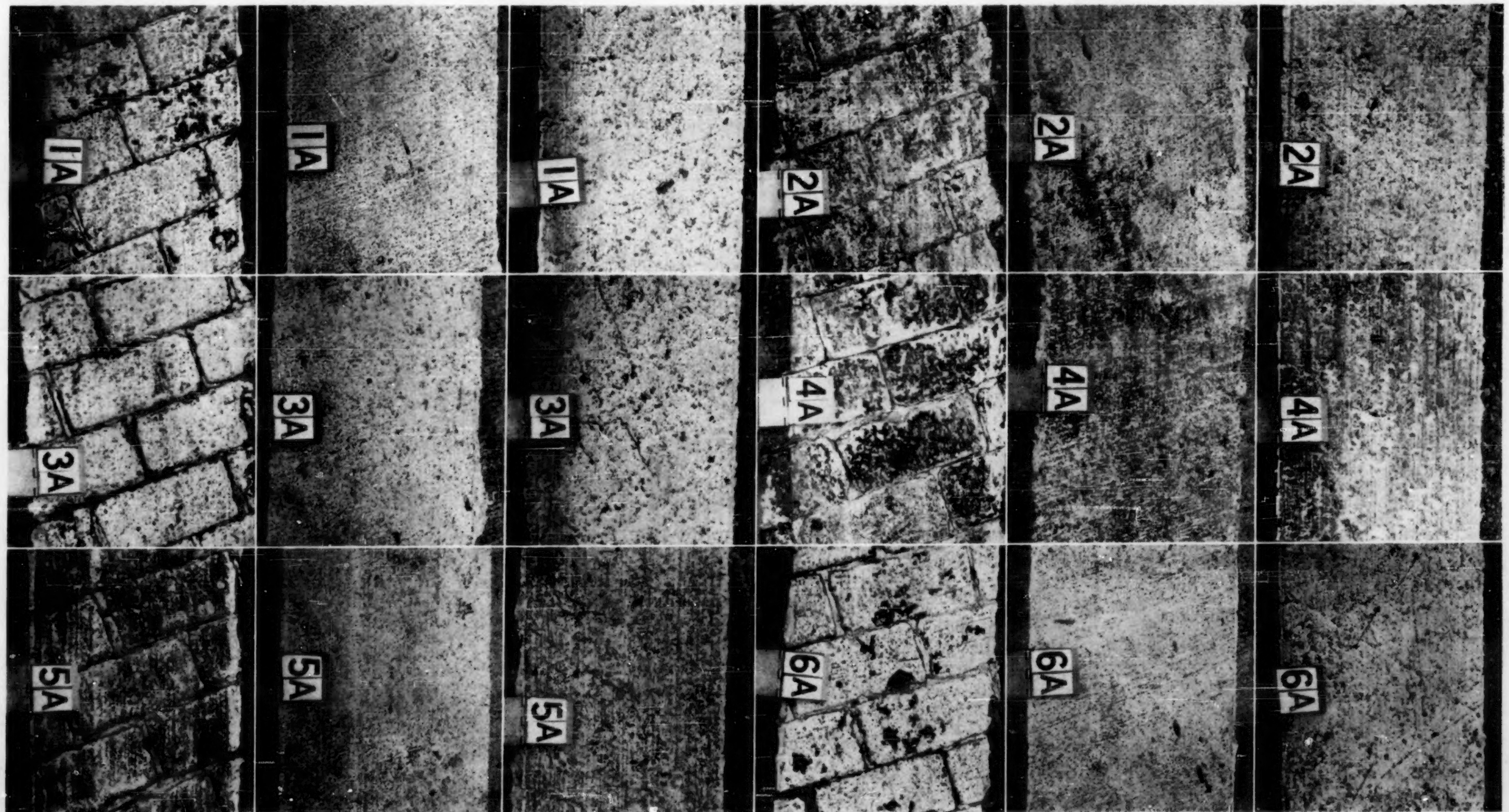
TABLE II.—SUMMATION OF HARDNESS TESTS.

Cooperator[a]	Method of Test	Test Conditions: Type Panel	Blade Clearance, in.	Aging Period	Cooperators' Results: Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7	Sample No. 8
No. 1......	.....											
No. 2......	.....											
No. 3......	Knife Point	Glass	0.003	Overnight	Soft ribbons	Hard ribbons	Hard ribbons	Very hard, sl. brittle	Very hard, brittle	Med. hard ribbons	Hard ribbons	Very hard brittle
			0.005	Overnight	Soft ribbons	Med. hard ribbons	Hard ribbons	Very hard, sl. brittle	Very hard, brittle	Soft ribbons	Hard ribbons	Very hard brittle
			0.008	Overnight	Soft ribbons	Med. hard ribbons	Hard ribbons	Very hard, sl. brittle	Very hard, sl. brittle	Soft ribbons	Hard ribbons	Very hard, brittle
			0.01	Overnight	Very soft ribbons	Soft ribbons	Med. hard ribbons	Very hard sl. brittle	Very hard, sl. brittle	Very soft ribbons	Hard, sl. brittle	Very hard, brittle
No. 4......	Knife Point	Steel	0.005	18 hr. at 25 C. and 2 hr. at 50 C.	Ribbons	Ribbons	Ribbons	Ribbons	Ribbons	Ribbons	Ribbons	Flakes
No. 5......	Knife Point	...	...	7 days	Flakes	Ribbons	Flakes	Flakes	Flakes	Ribbons	Ribbons	Flakes
No. 6......	Sward Rocker[b]	Glass	0.006	6–8 days	4	4	5	4	4	3	4	13
No. 7......	.....											

[a] No. 1. Main State Highway Commission.
No. 2. Purdue University, Joint Highway Research Project.
No. 3. New Jersey Zinc Co., Research Division.
No. 4. National Bureau of Standards.
No. 5. State of New York, Department of Public Works, Division of Engineering.
No. 6. E. I. du Pont de Nemours, Pigment Division.
No. 7. Ohio Department of Highways, Bureau of Tests.
[b] Results given in number of oscillations. The higher the number the harder the paint film.

Cooperator[a]	Method of Test	Test Conditions					Cooperators' Results							
		Type Panels	Blade Clearance, In.	Aging Period	Immersion Time, hr.	Bath Temperature, deg. Cent.	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7	Sample No. 8
No. 1.....	....													
No. 2.....	....													
No. 3.....	....													
No. 4.....	From flexibility test	Steel	0.005	18 hr. at 25 C. and 2 hr. at 50 C.			O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	Unsatisfactory
No. 5.....	Water immersion	...	...	72 hr. 72 hr. 72 hr. and 18 hr.	18 6 6 and 1	Approx. 25 100 100	O.K. 6 hr. O.K.	O.K. 6 hr. ...	O.K. 6 hr. ...	O.K. 1 hr. ...	O.K. 6 hr. O.K.	O.K. 6 hr. O.K.	Blisters 6 hr. O.K.	O.K. 5 hr. ...
No. 6.....	Cross cut	Glass	0.006 0.015 0.03	10 to 12 days 10 to 12 days 10 to 12 days			Very good Bad Good	Good Good Good	Very good Good Good	Fair Very good Fair	Bad Bad Fair	Fair Very good Good	Good Very good Good	Very bad Very good Good
No. 7.....	....													

[a] See Table II for identification of cooperators.



Brick Pavement — Portland Cement Concrete Pavement — Bituminous Concrete Pavement — Brick Pavement — Portland Cement Concrete Pavement — Bituminous Concrete Pavement

Fig. 4.—Ohio 1943 Service Test—Four Months' Exposure.

TABLE IV.—SUMMATION OF FLEXIBILITY TESTS.

Cooperator[a]	Method of Test	Blade Clearance, In.	Pre-baking Drying Period	Baking Period, hr.	Baking Temp., deg. Cent.	Mandrel Size, in.	Cooperators' Results: Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7	Sample No. 8
No. 1.....	Maine State Highway	....	18 hr.	5	105 to 110	1/2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	Cracked peeled
No. 2.....	Joint Highway Research Project (12 Tests)[b]	Film thick., 0.001 and 0.002	72 hr.	0	...	1/8 and 1/2	8/12[c]	8/12	7/12	6/12	4/12	4/12	9/12	3/12
	Joint Highway Research Project (6 Tests)[b]	Film thick., 0.001	72 hr.	0	...	1/8 and 1/2	5/6[c]	5/6	5/6	4/6	3/6	3/6	5/6	2/6
No. 3.....	TT-P-115 (Rev. 2-11-42)*	0.005	18 hr.	5	105 to 110	1/2	No cracks	Very fine cracks	No cracks	No cracks	Very fine cracks	Very fine cracks	Very fine cracks	Shatters
				6	105 to 110	1/8	O.K.	Cracked	O.K.	O.K.	Cracked	Cracked	O.K.	Shattered
	Ohio Highway Department	....	....	6	105 to 110	1/4	O.K.	Cracked	O.K.	O.K.	Cracked	Cracked	O.K.	Shattered
				6	105 to 110	1/2	O.K.	O.K.	O.K.	O.K.	Cracked	Cracked	O.K.	Shattered
				5	105 to 110	1/8	O.K.	Cracked	O.K.	O.K.	Cracked	Cracked	O.K.	Shattered
	TT-P-115*	0.005	18 hr.	5	105 to 110	1/4	O.K.	O.K.	O.K.	O.K.	Cracked	Cracked	O.K.	Shattered
				5	105 to 110	1/2	O.K.	O.K.	O.K.	O.K.	Cracked	Cracked	O.K.	Shattered
			18 hr.	2	50	1/8	O.K.	Cracked	O.K.	Cracked	Shattered	Cracked	Cracked	Shattered
			18 hr.	2	50	1/4	O.K.	O.K.	O.K.	O.K.	Cracked	Cracked	O.K.	Cracked
			18 hr.	2	50	1/2	O.K.	O.K.	O.K.	O.K.	O.K.	Cracked	O.K.	Cracked
			18 hr.	2	105	1/8	Cracked	Slight cracking	Cracked	Cracked	Shattered	Cracked	Cracked	Shattered
No. 4.....	Bell conical mandrel	0.005	18 hr.	2	105	1/4	Cracked	Slight cracking	Cracked	Slight cracking	Shattered	Cracked	Cracked	Shattered
			18 hr.	2	105	1/2	O.K.	O.K.	Cracked	O.K.	Cracked	Cracked	O.K.	Shattered
			0	6	105	1/8	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Shattered
			0	6	105	1/4	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Cracked	Shattered
			0	6	105	1/2	O.K.	O.K.	Cracked	O.K.	Cracked	Cracked	Cracked	Shattered
No. 5.....	New York	....	....	...	...	1/8	Cracks	Cracks	Cracks	Cracks	Cracks	Cracks	Cracks	Cracks
						1/2	O K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	Cracks
		0.006	4–6 days	0	...	1/8	Fair	Poor	Fair	Fair	Poor, flaky	Fair	No cracks	Bad, poor adhesion
		0.015	4–6 days	0	...	1/8	Poor	Poor	Poor	Poor, flaky	Poor	Poor	Poor	Bad, poor adhesion
		0.03	4–6 days	0	...	1/8	Bad, flaky	Bad, flaky	Bad, flaky	Bad, flaky	Bad	Bad	Bad, flaky	Bad, poor adhesion
		0.006	6–8 days	0	...	3/8	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Bad, very poor adhesion
		0.015	6–8 days	0	...	3/8	Fair	Poor	Poor	Bad, flaky	Bad	Poor	Bad, flaky	Bad, poor adhesion
No. 6.....	TT-P-51a TT-E-506a*	0.03	6–8 days	0	...	3/8	Bad	Bad, flaky	Poor	Bad	Bad	Poor, soft film underneath	Poor	Bad, adhesion not so noticeable
		0.006	6–8 days	0	...	1/2	Good	No cracks	Good	Fair	Poor	Fair	No cracks	Bad, very bad adhesion
		0.015	6–8 days	0	...	1/2	Fair	Fair, sl. flaky	Fair	Poor, flaky	Bad, poor adhesion	Fair	Flaky	Bad, very bad adhesion
		0.03	6–8 days	0	...	1/2	Bad, flaky, very poor adhesion	Bad, flaky, very poor adhesion	Fair	Bad, flaky	Poor	Poor	Bad, flaky	Bad, very bad adhesion
						1/8 at 0 C.	No cracking	No cracking	Slight cracking	No cracking	Very slight cracking	Cracking	Cracking	Shattered
No. 7.....	Ohio Highway Department	Film thick., 0.003	1/2 hr.	6	105 to 110	1/8 at 25 C.	No cracking	No cracking	Very slight cracking	No cracking	No cracking	Slight cracking	Slight cracking	Shattered
						1/2 at 25 C.	No cracking	No cracking	No cracking	No cracking	No cracking	No cracking	No cracking	Shattered

[a] No. 1. Maine State Highway Commission.
No. 2. Purdue University, Joint Highway Research Project.
No. 3. New Jersey Zinc Co., Research Division.
No. 4. National Bureau of Standards.
No. 5. State of New York, Department of Public Works, Division of Engineering.
No. 6. E. I. du Pont de Nemours, Pigment Division.
No. 7. Ohio Department of Highways, Bureau of Tests.

[b] Results of individual tests not reported. See Proc. Highway Research Board, V. 21, pp. 233–259, 1941, for methods used.

[c] Denominator is number of tests. Numerator indicates number of tests passed.

* Federal Specification.

TABLE V.—SUMMATION OF ABRASION TESTS AND COMPARISON WITH FIELD SERVICE RATINGS.

Cooperator[a]	Method of Test	Relative Order of Abrasion (Wear) Resistance (1—best; 8—poorest): Wet Abrasion								Dry Abrasion								Alternate Wet and Dry Abrasion								Cooperators' Rating							
Sample	Number............	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
No. 1...	Main State Highway	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	2	4	5	3	6	1	7	8	2	4	5	3	6	1	7
No. 2[b]..	Modified Dorry Hardness	7	3	1	8	4	2	6	5	4	3	1	8	7	2	5	6	..	..	..	..	..	..	..	..	7	3	1	8	4	2	6	5
No. 3...	New Jersey Zinc	8	6	3	3	2	1	5	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	6	3	3	2	1	5	7
No. 4...	Taber Abraser	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	2	4	5	3	6	1	7
No. 5...	Doory Hardness Machine	8	2	4	6	4	3	7	1	4	1	3	8	7	4	4	1	..	..	..	..	..	..	..	..	7	2	3	8	5	3	6	1
No. 6...	TT-P-23a TT-P-88*	8	3	3	7	6	5	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	3	3	7	6	5	1	2
No. 7...	Field Service Test	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	1	3	6	4	5	2	7

[a] No. 1. Main State Highway Commission.
No. 2. Purdue University, Joint Highway Research Project.
No. 3. New Jersey Zinc Co., Research Division.
No. 4. National Bureau of Standards.
No. 5. State of New York, Department of Public Works, Division of Engineering.
No. 6. E. I. du Pont de Nemours, Pigment Division.
No. 7. Ohio Department of Highways, Bureau of Tests.
[b] Cooperators' rating of abrasion taken from anticipated order of durability, as no method of weighting was indicated for wet and dry abrasion tests.
* Federal Specifications.

TABLE VI.—SERIES A PAINTS. ABRASION AND FIELD SERVICE COMPARISON.

Cooperator[a]	Method of Test	Cooperators' Rating[b]: Sample No. 1A	Sample No. 2A	Sample No. 3A	Sample No. 4A	Sample No. 5A	Sample No. 6A
No. 1..	Dry abrasion	2	5	3	6	4	1
	Wet abrasion	1	4	2	5	3	6
	Average of wet and dry abrasion	1	5	2	6	4	3
No. 3....	Accelerated weathering plus New Jersey Zinc Abraser	2	5	3	6	4	1
No. 4..	Two weeks' exposure plus Taber Abraser	2	4	6	5	3	1
	Accelerated weathering plus Taber Abraser	2	5	3	6	4	1
	Six months' field service	2	4	3	5	6	1
No. 7....	Four months' field service	2	4	3	6	5	1

[a] No. 1. Main State Highway Commission.
No. 3. New Jersey Zinc Company, Research Division.
No. 4. National Bureau of Standards.
No. 7. Ohio Department of Highways, Bureau of Tests.
[b] 1 = Best. 6 = Worst.

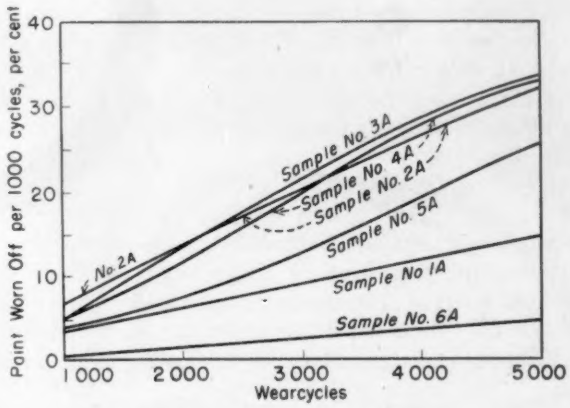


Fig. 5.—Results of Taber Abraser Test.
CS10 Wheels; 500-g. Pressure

TABLE VII.—DEGREE OF ABRASION OF PAINT FILM.[a]

Sample	20 Revolutions	40 Revolutions	60 Revolutions	80 Revolutions	100 Revolutions	200 Revolutions	300 Revolutions	400 Revolutions	500 Revolutions	600 Revolutions	700 Revolutions	800 Revolutions	900 Revolutions	Relative Durability of Paints
No. 1A....................	0	0	0	0	0	2	3+	5	6	7	8	9	9+	2nd
No. 2A....................	2	3	4	6	7	9	10 (280)	..	..	..	..	..	..	5th
No. 3A....................	1	1+	2	3	3+	5	6	7	8	9	10	..	..	3rd
No. 4A....................	4	5+	7	8	9+	10 (120)	..	..	..	..	..	..	..	Poorest
No. 5A....................	0	1	2	3	4	7	8	9	10	..	..	..	..	4th
No. 6A....................	0	0	0	0	0	1	1+	2	3	3+	4	5	6	Best
Control[b]................	0	0	0	0	0	0	1	2	2+	3	3+	4	5	

[a] Degree of abrasion of paint film in which 0 signifies none and 10 signifies complete removal of the paint film.
[b] Paint prepared in this laboratory according to old Federal Specification TT-P-115 (15 gal. Amberol F-7 tung-linseed vehicle) using titanated lithopone as the opaque pigment.

Mr. Hickson, the group chairman suggested that, since such good correlation was obtained by this method, Mr. Leavitt continue the use of his method with the current samples of paint.

Conclusions

Results of the work to date, as outlined above, lead to the following conclusions:

1. The adhesion, flexibility, and hardness tests examined show no general correlation with field service behavior.

2. The abrasion test developed by Mr. Leavitt and the combined accelerated weathering and abrasion tests developed by Mr. Hickson and Mr. Werthan show very close correlation with field service behavior of the samples of traffic paint examined.

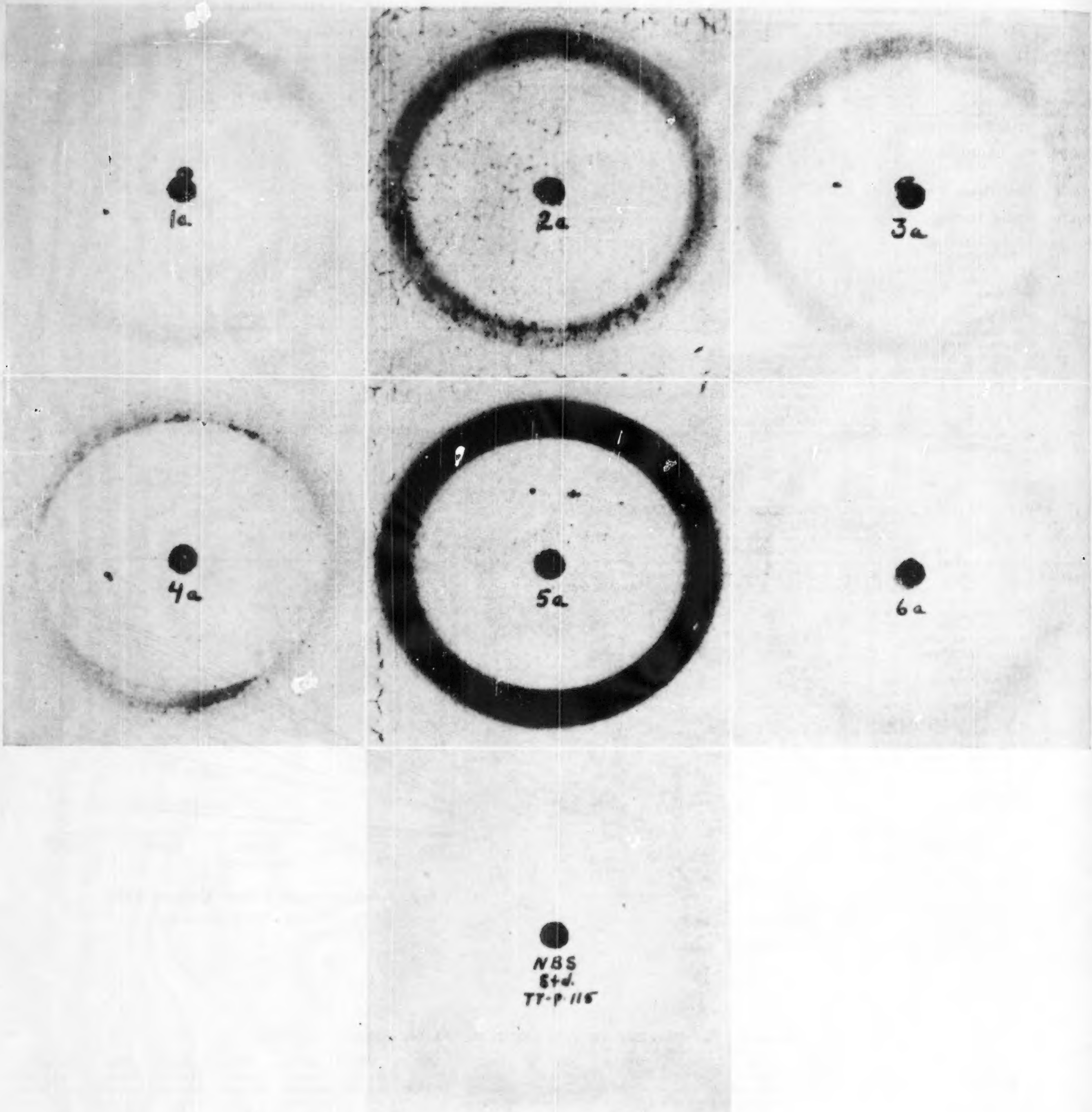


Fig. 6.—Taber Abraser Tests on A.S.T.M. Traffic Paints.

CS15 Wheels, 1000-g. Pressure; 2000 Wearcycles. Panels Exposed 168 hr. in Eveready Accelerated Testing Unit.

Wanted—1936 Radiography and X-ray Symposium

ALTHOUGH the 1936 Symposium on Radiography and X-ray Diffraction, one of the outstanding publications issued by the Society, has been out of print for many months, the Society continually receives orders and urgent requests for the publication. It has been suggested that some members who have this book may be willing to dispose of it to the Society, since a considerable portion of the material involving radiography has been reprinted or abstracted in the 1943 Symposium on Radiography. Many of the recent requests for the 1936 book are traced to the continuing interest in the several papers on X-ray diffraction. The Society would like to buy back a limited number of the books at $2 each and members who would be willing to return their books should communicate with A.S.T.M. Headquarters.

A.S.H.V.E. Research Booklet

RECENTLY published by the American Society of Heating and Ventilating Engineers is a 32-page booklet describing 28 projects on which work is under way or is to be undertaken through the Committee on Research either at the research laboratory of the Society in Cleveland or at cooperating institutions. The A.S.H.V.E., 51 Madison Ave., New York 10, N. Y., will be glad to mail a copy of this booklet on request to any members of the A.S.T.M.

Investigation of Graphitization of Piping[1]

By H. N. Boetcher[2]

FOLLOWING THE discovery of graphitization in the pipe at Springdale Station, we made an extensive survey of the piping of the Westport superposed unit after 22,000 to 23,000 service hours and an exploratory survey of the piping of two condensing units, which had been in service for shorter periods of time. The throttle steam temperature of all these units is in the neighborhood of 900 F. A second survey of the piping of the superposed unit was made after about 29,000 service hours. In connection with the examinations, samples of the Springdale piping were also examined. Furthermore, a number of specimens of Springdale and Westport pipe have been examined after exposure to 1100 F. for about 7000 to 7500 hr. Further work is under way with heating tests at 1125 F., and a cooperative program has been set up with a pipe manufacturer for a thorough investigation of large size pipe made from special experimental heats.

Service Graphitization:

No graphite was found in the piping of the condensing units. We contemplate taking supplementary sets of specimens after these units have had longer service.

Most of the samples were taken by "Weld Prober." The sampling of the piping of the units covered castings, forgings, pipe of steel killed with about 0.5 lb. of aluminum, pipe of steel killed with about 1.0 lb. of aluminum, and pipe of steel killed with 1.5 to 2 lb. of aluminum per net ton. No graphite was found in any casting, such as the header and valve bodies. A trace of graphite was found in a forged ell. Traces were found also in one each length of pipe killed with 0.5 and 1.5 to 2 lb. of aluminum, respectively. All of these were located in the "critical zone," near welds. Representative photographs of this dispersed graphite are shown by Fig. 1. Fairly heavy graphitization was found in one length of pipe of high aluminum-killed steel; but none of it was of the "plate type" prevalent at Springdale. It should be noted that, with the exception of the piece of pipe designated "1-17," the amounts of graphite found were minute and that many pieces of pipe of both low and high aluminum-killed steel were in series with these lengths, but did not show any graphite.

A thorough examination of pipe "1-17" which was replaced after 29,000 service hours is under way. Graphite was found in this length in concentrated form in the "critical zones" near the two welds and dispersed throughout the length of pipe. A comparison of the conditions found after 23,000 and 29,000 service hours, respectively, is difficult since the amounts vary considerably even within any one specimen. We feel fairly certain that the amount of graphite dispersed throughout the pipe increased appreciably, but are not certain of appreciable increases in the "critical zones." The conditions found during the two surveys are shown by Figs. 2 to 5. An idea of the extent of graphitization experienced in the pipe proper is given by chemical analyses which showed graphite contents of 0.024 and 0.029 per cent, respectively, in two samples with a total carbon content of 0.118 per cent. This indicates that over 20 per cent of the carbon has been graphitized.

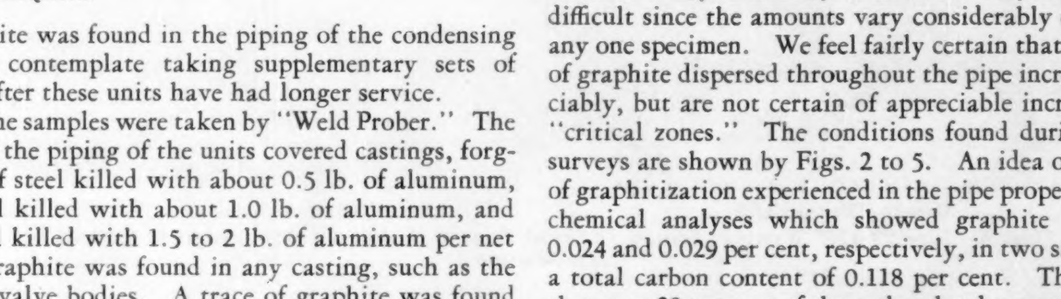
Tentative Conclusions and Experimental Work:

No conclusions have been reached, as yet, regarding the conditions which make a steel basically susceptible to graphitization. In agreement with others, we found that steels showing appreciable service graphitization had relatively large amounts of metallic aluminum (above 0.003 per cent), but not necessarily much aluminum oxide. The effect of normality of the steel on susceptibility to graphitization is being kept in mind. All tests made so far showed the pipe steels to be abnormal, regardless of whether they graphitized in service or not. If it is true, therefore, that abnormal steels are susceptible to graphitization, other

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the authors. Address all communications to A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia 2, Pa.

[1] This paper was presented during the 1944 A.S.T.M. Annual Meeting in New York City, June 26–30, 1944, in an informal session sponsored by Project 29 on Graphitization of Steel Piping functioning under the Joint A.S.T.M. - A.S.M.E. Research Committee on Effect of Temperature on the Properties of Metals. In addition to Mr. Boetcher's paper there was discussion by a number of other authorities in this field. Mimeographed copies of the discussion are to be issued, available on request from A.S.T.M. Meanwhile Project 29 has been planning a program of work to develop authoritative information on this very complicated but urgent problem. Additional discussions in the form of five technical papers will be given on December 1 during the meeting of The American Society of Mechanical Engineers in New York City.

[2] Assistant to Superintendent, Power Production Stations, Consolidated Gas Electric Light and Power Co. of Baltimore, Baltimore, Md.

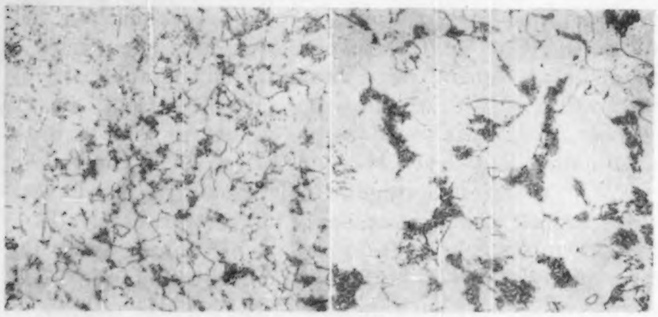


(*a*) Killed with 0.5 lb. of aluminum. (*b*) Killed with 1.5 to 2.0 lb. of aluminum.

Fig. 1.—Dispersed Graphite in Critical Zone at Weld of Carbon-Molybdenum Steel Pipe. (× 1000, reduced one half in reproduction.)

factors must determine whether graphitization will actually occur or not.

One factor which, in our opinion, is definitely of importance is the microstructure of the steel. A review of photomicrographs seems to show that graphitization takes place only in coarsely spheroidized steel. This is shown

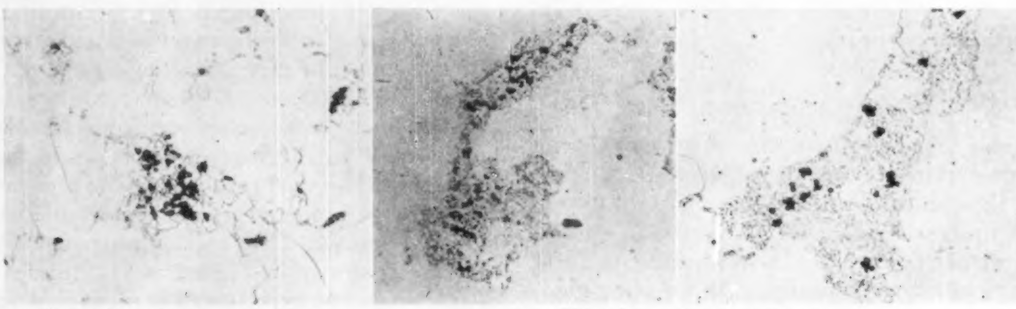


(*a*) After 22,171 service hours. (*b*) After 29,000 service hours

Fig. 2.—Pipe "1-17," Westport Station. Critical zone at weld. (× 200, reduced one half in reproduction.)

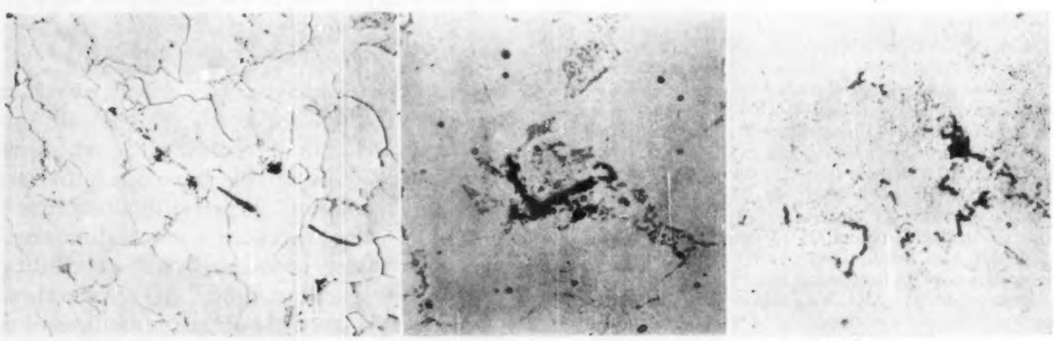
in a number of the photographs which frequently include individual spheroids in a stage of incipient graphitization. It is not necessary that the entire steel or even the entire carbide grain has been spheroidized. Figure 6 (*a*), for instance, shows a graphitized spheroid in an otherwise mostly pearlitic carbide grain. These findings are in agreement with a statement by Prof. A. E. White according to which a "lacy" structure favors the development of dispersed graphite throughout the pipe and a Widmanstätten structure, in spite of fine spheroidization in heat treatment or service, suppresses graphitization, but leads to sharply accentuated and concentrated graphitization in the narrow, coarsely spheroidized critical zone near a weld. In our observations, a pearlitic structure also obstructs the development of graphite, though not as rigidly as a Widmanstätten structure, probably due to the presence of some spheroidal carbides in most pearlitic grains.

The importance of the microstructure makes it appear necessary to consider the results of accelerated graphitization tests at temperatures above the range occurring in serv-



(*a*) After 22,171 service hours. (*b*) After 29,000 service hours.

Fig. 3.—Pipe "1-17," Westport Station. Critical Zone at Weld. (× 750, reduced one half in reproduction.)

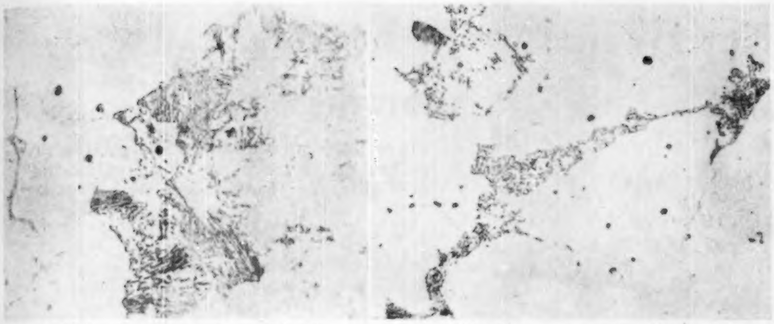


(*a*) After 22,171 service hours. (*b*) After 29,000 service hours.

Fig. 4.—Pipe "1-17," Westport Station. At Distance of 1/2 in. from Weld. (× 750, reduced one half in reproduction.)

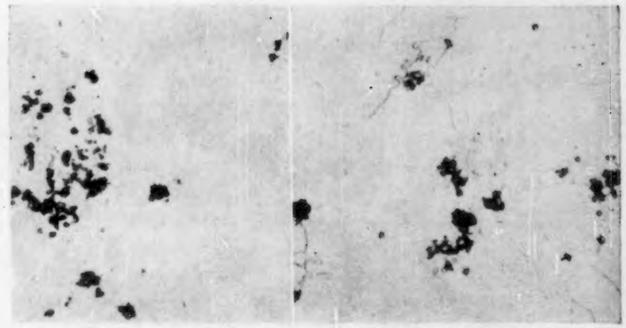
Fig. 5.—Pipe "1-17," Westport Station. Five Feet from Weld. (× 1200, reduced one half in reproduction.)

ice, on the basis of the possibility of changes in microstructure which would not occur at service temperatures within the length of normal service life. We do not believe that enough information is available, or has been coordinated, on this important item, at present. Our own tests at 1100 F. do not offer conclusive results on this point. It seems that the coarse spheroids which initiated service graphitization in the critical zone at welds or in the pipe proper were present when the piping went into service. Figure 6 (*b*) shows the initial structure of pipe "1-17." We are, however, aware of the fact that many factors other than spheroidization are involved as indicated also by the reported decrease in rate of graphitization above



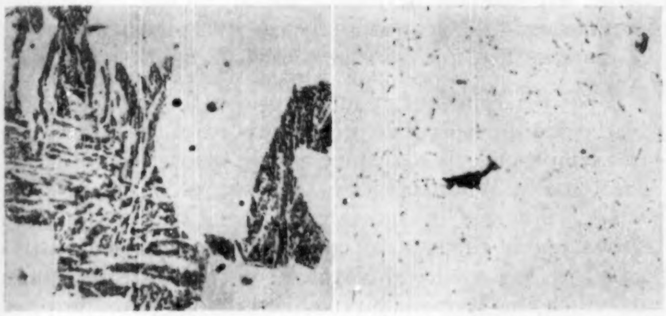
(*a*) One spot of graphite in spheroids of otherwise largely pearlitic grain. (*b*) Structure as installed.

Fig. 6.—Pipe "1-17," Westport Station. (× 750, reduced one half in reproduction.)



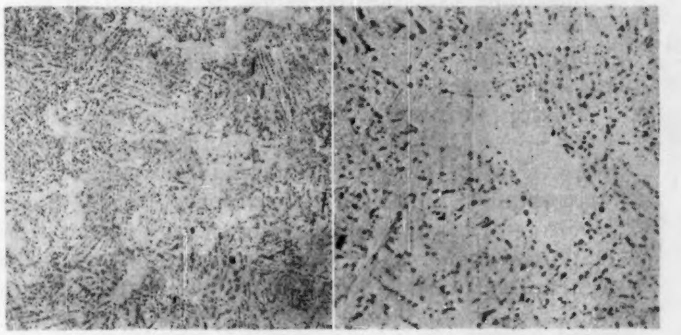
(*a*) (*b*)

Fig. 7.—Pipe "1-17," Westport Station. Removed After 22,171 Service Hours, then Heated 7000 Hr. at 1100 F. Critical Zone Near Weld. (× 750, reduced one half in reproduction)



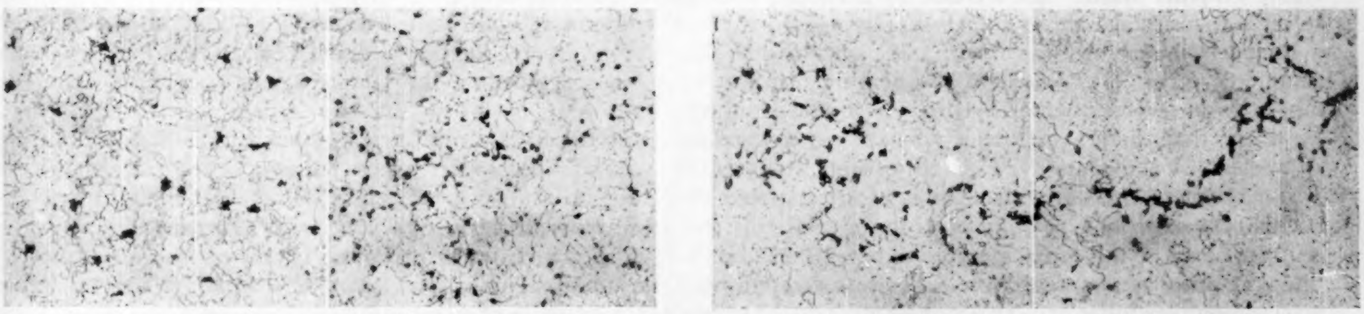
(*a*) As removed from service. (*b*) After 7000 hr. at 1100 F., following removal from service.

Fig. 8.—Springdale Station Pipe, General Structure. (× 750, reduced one half in reproduction.)



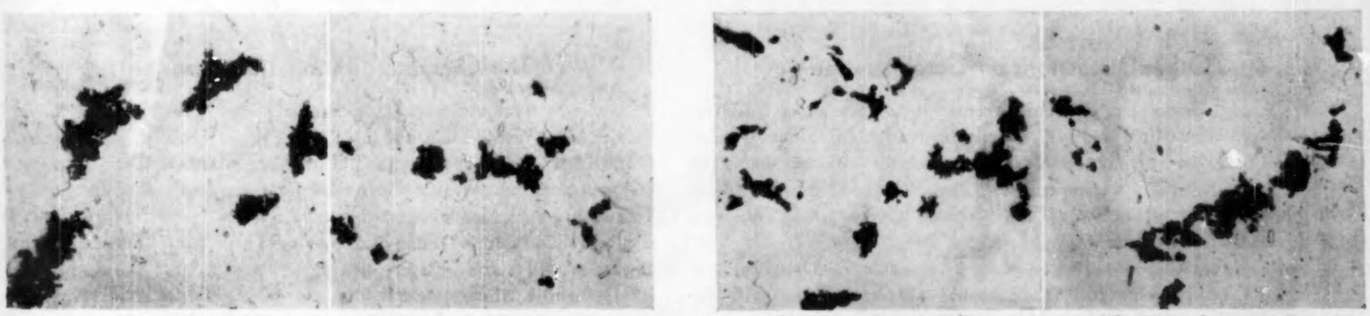
(*a*) × 200, reduced one half in reproduction. (*b*) × 750, reduced one half in reproduction.

Fig. 9.—Pipe Steel, Killed with 1.5 to 2.0 lb. of Aluminum, Heated to 2150 F., then Heated at 1100 F. for 7000 hr.



(*a*) Heated to 2000 F. (*b*) Heated to 2050 F. (*c*) Heated to 2100 F. (*d*) Heated to 2150 F.

Fig. 10—Graphitization in "Critical Zone" at Welds of Carbon-Molybdenum Steel Pipe Killed with 1.5 to 2.0 lb. of Aluminum, in 7000 hr. at 1100 F., after Heat Treatments as Indicated. (× 200, reduced one half in reproduction.)



(*a*) Heated to 2000 F. (*b*) Heated to 2050 F. (*c*) Heated to 2100 F. (*d*) Heated to 2150 F.

Fig. 11.—Graphitization in "Critical Zone" at Welds of Carbon-Molybdenum Steel Pipe Killed with 1.5 to 2.0 lb. of Aluminum in 7000 hr. at 1100 F., After Heat Treatments as Indicated. (× 750, reduced one half in reproduction.)

Fig. 12.—Springdale Pipe. Graphitization in Service in "Critical Zone" at Welds, for Comparison with Figs. 10 and 11.

(*a*) × 750, reduced one half in reproduction. (*b*) × 1000, reduced one half in reproduction.

1100 F. in spite of the increased trend toward spheroidization.

Regarding experimental work, we completed and are now analyzing a test run at 1100 F. for 7000 to 7500 hr. We contemplate and are preparing future work in which the experiences of the first test will be considered.

Though, as a result of our failure to protect the specimens from free access of air, many of the specimens tested at 1100 F. were badly decarburized, a few significant results were obtained. The test had two purposes. One was to investigate, at a possibly accelerated rate, the progress of graphitization already started in service. The second was to investigate certain factors then thought to be of importance.

The investigation of the progress of graphitization already started was probably affected by the decarburization which deprived the steel of carbon which otherwise would have been available for the formation of graphite. Decarburization did not seem to remove any of the relatively stable graphite itself. An increase in graphite, both in relation to residual carbides and absolutely, is evident from a comparison of Fig. 7 with Fig. 3 (*a*) and others. The sample of pipe "1–17" used in the heating test was removed from service after 22,171 hr. It should be noted, however, that there is no trend, whatsoever, toward development of the plate type graphite such as found at Springdale. In this connection, it is of interest that the effect of the *dispersed* type of graphite in the relatively concentrated form in the "critical zone" of pipe "1-17" on the physical properties is negligible. Bending tests showed no cracking even when enough graphite was present to produce visible "eyebrows" as was the case in "1-17" after 29,000 service hours. Tension impact tests with specimens including the weld with appreciable lengths of pipe at both sides showed ductile failures, with average energy consumption of 107 ft-lb., in the pipe at either side of the weld, but nowhere near the lines of graphite. For comparison, a similar specimen of Springdale pipe had a brittle fracture in the "critical zone," with 18 ft-lb.

A potential effect of a temperature of 1100 F. is suggested by the development of dispersed graphite in the pipe proper of a sample of Springdale pipe which, as inserted in the furnace, had a Widmanstätten structure as shown by Fig. 8 (*a*). Figure 8 (*b*) indicates dispersal of spheroids and shows one of the spots of graphite found. It is possible that the long service at elevated sub-critical temperatures to which the Springdale pipe had been subjected prior to the test affected the results. A sample of Westport pipe (also high aluminum killed), heated to 2150 F. before welding, retained a Widmanstätten pattern in 7000 hr. at 1100 F., with fine spheroidization, and developed no graphite (see Fig. 9).

Samples of a piece of pipe killed with 1.5 to 2 lb. of aluminum were heated to 2000, 2050, 2100, and 2150 F., respectively, then welded and kept at 1100 F. for 7000 hr. On examination, the sample heated to 2150 F. definitely showed "eyebrows" in the critical zone. All of these specimens developed graphite in the critical zone, but not in the pipe proper. A comparison of the photographs in Fig. 10 suggests a trend toward concentration of the graphite in the critical zone with increasing temperatures of heat treatment. Figure 11 shows the structures at higher magnification. As a very tentative conclusion, in the presence of so far insufficient evidence, the trend, with increasing temperature in heat treatment before service or test, seems to be toward the Springdale structures shown by Fig. 12.

Other Discussions on Graphitization

Several discussions presented in the Session on Graphitization have been edited and will shortly be available in mimeographed form. Copies of this material can be obtained without charge by writing to A.S.T.M. Headquarters. This material together with Mr. Boetcher's paper presented above should give a good conception of topics discussed at the meeting.

Five technical papers are to be given at a session on December 1 in New York City, during the ASME annual meeting. These will discuss various aspects of graphitization.

The Chemist and Insulation Research

Received from the Committee on Chemistry of the Conference on Electrical Insulation, functioning under the National Research Council is a 72-page book entitled "Contributions of the Chemist to Insulation Research" covering the period January, 1943, to January, 1944. This includes detailed statements usually with extended bibliography on the following subjects: Field of Anomalous Dispersion, Rubber Electrical Insulation, Insulating Paper, Synthetic Plastic Electrical Insulating, Insulating Oils, and Ceramic Electrical Insulation. Those preparing the reviews are in close touch with the respective fields covered. Copy of this publication can be obtained from the Committee Chairman G. T. Kohman, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

The Reaction of Vinsol Resin as It Affects the Air Entrainment of Portland-Cement Concrete*

By Charles E. Wuerpel[1] and Albert Weiner[1]

The Central Concrete Laboratory, by authorization of the Office of the Chief of Engineers, U. S. Army, undertook in 1939 an extensive investigation of cement durability. Of the 52 cements included in this program, six exhibited outstandingly superior durability and all six were found to contain air-entraining agents.[2] This discovery led, in 1941, to the specifying of Vinsol resin treated portland cement for use on certain projects constructed by the Corps of Engineers. Up to the present time this laboratory has tested in excess of 1,800,000 bbl. of Vinsol-resin cement for use in military construction. In general, this material, as controlled by the requirements of Federal[3] or A.S.T.M. Specifications[4] has been found to be satisfactory and its use has resulted in concrete of superior durability. In a few instances, however, cements conforming to the specifications have entrained excessive amounts of air in concrete.

Evidence from field construction indicated that the air content of concrete made with portland cement containing Vinsol resin was not closely predictable from the amount of Vinsol resin present in the cement as specified in A.S.T.M. Specifications C 175.[4] In order to determine means by which the air entrainment could be made regulable to a reasonable degree, it was necessary first to learn the nature of the reaction between Vinsol resin and portland cement. It is the results of this investigation which are presented in this paper.

Cements with Interground Flake Vinsol Resin

The 106 cements included in the first phase of this study, representing the product of 19 mills, contained flake Vinsol resin interground at the mill. Chemical analysis revealed a range of 0.019 to 0.069 per cent Vinsol resin by weight of the cement.

Since it was found that about two- and one-half times more air was entrained by Vinsol resin treated cement in mortar than in concrete, it was decided to use mortars for these tests. Standard mortars were prepared in accordance with A.S.T.M. C 109 – 43 T[5] except that a mechanical mixer (Lancaster model TM) and a mixing time of 4 min. were used. The air content was computed from the reduction in volume when a known volume of mortar was subjected to a pressure of 20 mm. of mercury. Alkalinity, Vinsol resin in solution, and alkali in solution were determined chemically on an aqueous extract, which was obtained by filtering a portion of the mortar under reduced pressure. The relations of the data developed by these tests are shown in Figs. 1 and 2.

Figure 1 (*a*) shows that there is no direct correlation between the air content of the mortars and the Vinsol resin content of the cements. Figure 1 (*b*), on the other hand, shows that a fairly well-defined, linear relationship exists between the air content of the mortar and the Vinsol resin content of the extract. Figure 2 shows the absence of correlation between either alkalinity or alkali content of the extract and Vinsol resin content of the extract. These conclusions are in general agreement with those reported by McCoy.[6]

On the basis of the determined alkali contents of the

[6] W. J. McCoy, "Investigation of the Air-Entraining Properties of Portland Cements Effected by the Addition of Vinsol Resin," ASTM Bulletin, No. 127, March, 1944, p. 22.

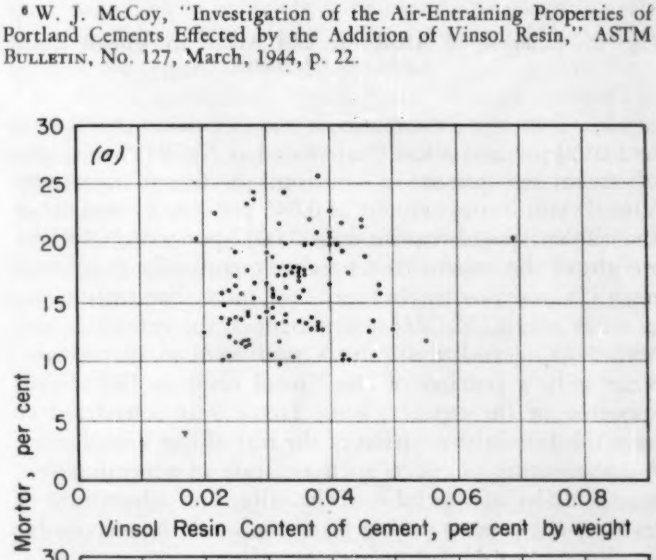


Fig. 1.—Relation of Air Content of Mortar to Vinsol Resin Content of Cement and of Mortar Extract.

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* Presented at the Forty-seventh Annual Meeting, Am. Soc. Testing Mats., New York, N. Y., June 26-30, 1944.

[1] Engineer-in-Charge and Assistant Engineer, respectively, Central Concrete Laboratory, Corps of Engineers, U. S. Army, Mount Vernon, N. Y.

[2] "Cement Durability Program—First Interim Report," Central Concrete Laboratory, Mount Vernon, N. Y. (1942).

[3] Federal Specifications E-SS-C-191b and E-SS-C-206a.

[4] Emergency Alternate Specifications for Portland Cement (EA - C 150) and Tentative Specifications for Treated Portland Cement for Concrete Pavements (C 175 – 42 T), 1942 Book of A.S.T.M. Standards, Part II, pp. 1017 and 1055, respectively.

[5] A.S.T.M. Book of Standards, 1943 Supplement, Part II, p. 79.

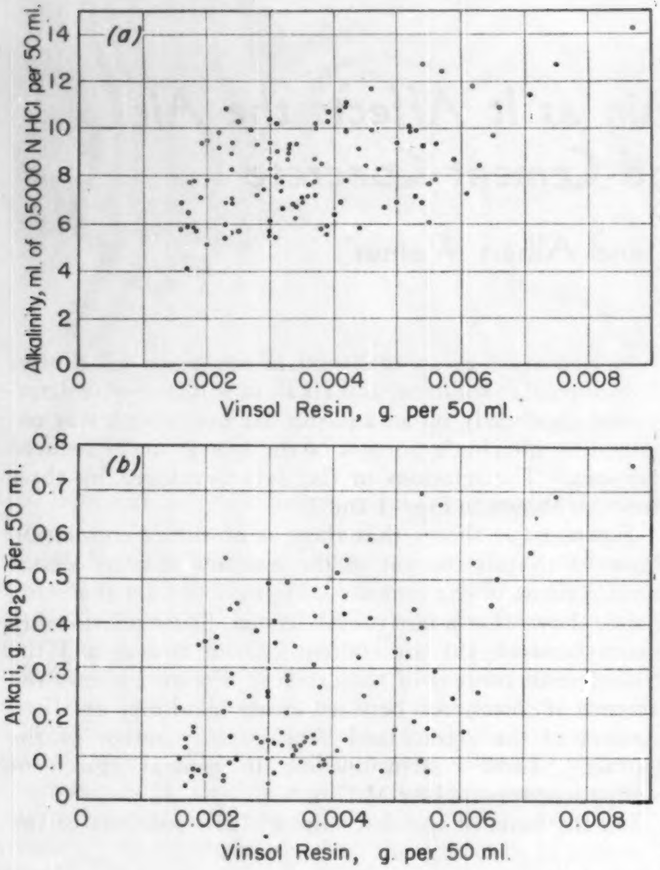

Fig. 2.—Relation of Alkalinity and Alkali to Vinsol Resin Content of Extract.

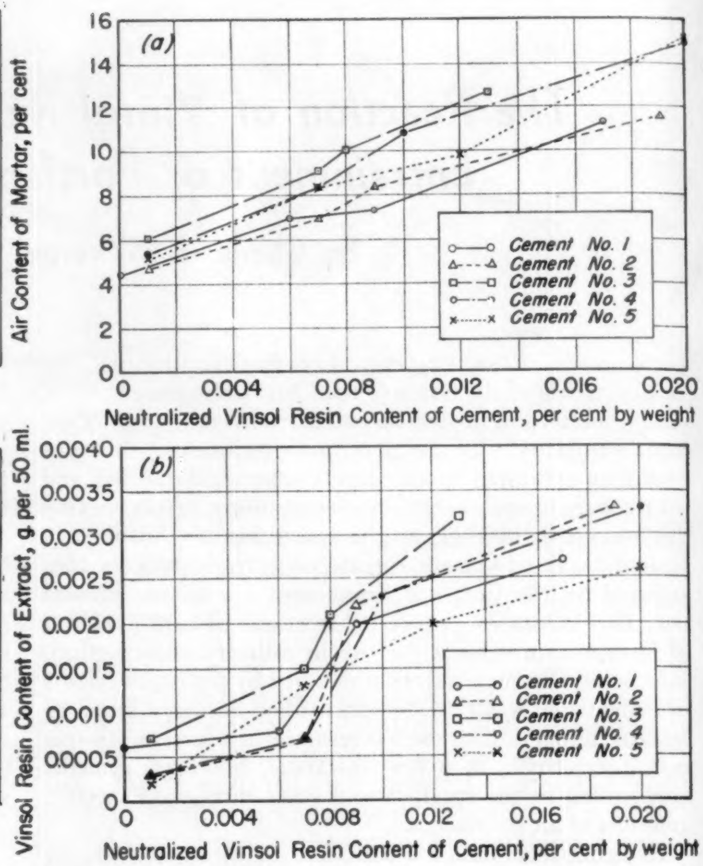

Fig. 3.—Relation of Neutralized Vinsol Resin Content of Cement to Air Content of Mortar and Vinsol Resin Content of Extract.

extracts from the 106 cements, it was calculated that 0.0265 to 1.0350 per cent alkali (calculated as NaOH) by weight of cement was present in solution. A cement containing Vinsol resin in the amount of 0.045 per cent by weight of the cement would require only 0.0032 per cent NaOH by weight of the cement to neutralize completely the Vinsol resin.[7] Consequently, in every case, more than eight times as much alkali (NaOH) was present in the extract as was needed to neutralize all the Vinsol resin in the cement. Since only a portion of the Vinsol resin in the cement appeared in the extract, some factor was considered to have inhibited the solution of the rest of the Vinsol resin. A combination of effects such as: rate of neutralization, precipitation of insoluble resin salts, and adsorption of resin by the cement during grinding, could be responsible for this partial inhibition.

Addition of Neutralized Vinsol Resin to Mixing Water

The indication that the variation of air content was caused by the variable amount of Vinsol resin going into solution, suggested an investigation of the possibility of adding *neutralized* Vinsol resin to the cement. Accordingly mortars were made with nine untreated cements, in the preparation of which amounts of the sodium salt of Vinsol resin, equivalent to 0.01 per cent Vinsol resin by weight of the cement, where added to the mixing water. Tests of air content similar to those described above were conducted on these mortars and on mortars made from the same cements to which no resinate was added. Table I contains the results of these tests with similar values from tests on cements containing interground flake Vinsol resin.

TABLE I.

Vinsol Resin in Cement		Number of Cements in Group	Air Content of Mortar, per cent		
Form in Which Added	Per Cent Added, by Weight		Average	Average Deviation from Mean	Difference Between Maximum and Minimum
None	None	9	5.7	0.9	2.9
Neutralized	0.01	9	10.7	0.8	2.5
Interground, flake	0.027	7	14.8	3.0	11.7
Interground, flake	0.032	8	15.4	4.0	11.8
Interground, flake	0.033	7	14.5	4.0	10.8

From these data it appears that: (1) The use of neutralized Vinsol resin affords definite advantages over unneutralized flake Vinsol resin in the control of air entrainment. (2) The air contents of mortars made with cements containing neutralized Vinsol resin develop as much uniformity as air contents of mortars made from the same cements to which no Vinsol resin was added.

There is some evidence to support the belief that the particle-size distribution of the cement influences the air entrainment and, since this property might vary from grind to grind as well as from mill to mill, some lack of certainty in the air entrainment probably is inevitable. It is, therefore, not possible to obtain absolute control of the air content simply by means of a quantitative control of the air-entraining agent. Nevertheless, if, as indicated by the data given above, the variability of air content can be reduced by the use of neutralized Vinsol resin to about one quarter of that when unneutralized Vinsol resin is used, the neutralized resin is seen to have distinct advantages.

[7] Based on a value of 100 for the acid number of Vinsol resin, supplied by the Hercules Powder Co.

Cements with Interground Neutralized Vinsol Resin

On the basis of the promising results of the tests described above, an investigation of the behavior of neutralized Vinsol resin as an interground addition was begun. At each of five mills, single clinker burns were ground to prepare large samples (10 or 15 bbl.) of cement containing: (1) no Vinsol resin, (2) 0.03 per cent unneutralized Vinsol resin, (3) various amounts of neutralized Vinsol resin (sodium resinate).[8] Mortars were prepared from these

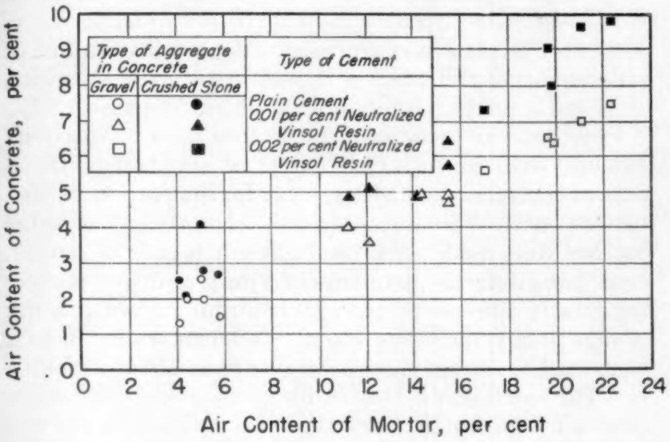

Fig. 4.—Relation of Air Content of Mortar to Air Content of Concrete.

cements and chemical and physical tests were conducted in the manner previously described. As in the case of the 106 cements originally tested, no correlation was found between the air content of the mortars and the Vinsol resin content of the cements to which *unneutralized* flake Vinsol resin had been added. However, Fig. 3 (*a*) shows that the relationship of air content of mortars to Vinsol resin content is nearly linear for those cements to which *neutralized* Vinsol resin (sodium resinate) had been added, and that the air contents of mortars containing similar amounts of interground neutralized Vinsol resin agreed as closely as the air contents of mortars made with cements containing no Vinsol resin. This substantiates the similar indication found in the earlier tests using neutralized Vinsol resin as an addition to the mixing water. Figure 3 (*b*) shows further that a fairly good correlation exists between the amount of Vinsol resin in the extracts and the amount in those cements to which the resinate was added.

Figure 4 shows the relationship which exists between the air entrained in mortar[9] and that entrained in concrete made with two types of coarse aggregate. These data are discussed in greater detail in the 1944 report of Committee C-1 on Cement,[8] but are reproduced herein to illustrate that: (1) a reasonably close relationship exists between the air entrained in the test mortar and that entrained in concrete, and (2) that the variation in air content is materially less in concrete than in the test mortar.

Summary

1. Cement, containing interground flake Vinsol resin, entrains an amount of air in mortar which is related *neither* to the Vinsol resin content of the cement, the alkalinity, nor the alkali content of the extract of the mortar.

2. The amount of air entrained in mortar is related to the amount of Vinsol resin dissolved in the extract from the mortar.

3. Although an amount of NaOH is found in the extract which is in excess of that needed to neutralize all the Vinsol resin in a cement, only a portion of the Vinsol resin in the cement is dissolved.

4. When neutralized Vinsol resin (sodium resinate) is interground with cement, a good correlation is found between the Vinsol resin content of the cement, air content of the mortar, and Vinsol resin content of the extract from the mortar.

5. Cements with equal amounts of neutralized Vinsol resin exhibit no greater variability in air-entrainment than do cements containing no Vinsol resin.

[8] See Appendix 1 to Report of Committee C-1 on Cement, *Proceedings*, Am. Soc. Testing Mats., Vol. 44, (1944).

[9] Proposed Tentative Method of Test for Determining the Air Content of Portland-Cement Mortar, Report of Committee C-1 on Cement, 1944 Preprint No. 41.

DISCUSSION

Mr. P. H. Bates.[1]—At the present time we have some work under way which was forced on us to a certain extent by producers who were putting in the required amount of Vinsol resin, according to their weights, and not finding it in the cement. As a consequence, we have been studying the effect of heat on the Vinsol resin, since all the grinding mills develop considerable heat, and find there is a marked effect. Just what it really means as to air entraining properties, we do not know.

Mr. Charles E. Wuerpel.[2]—We, also, have been unable to extract the amount of Vinsol resin from cement that the manufacturer claimed to have added. We have conducted tests of the volatility of Vinsol resin and have found that the temperature at which grinding takes place in some mills would cause volatilization of a certain amount of the Vinsol resin and, perhaps, a certain amount of adsorption of the Vinsol resin which would prevent its being extracted in the analysis.

Mr. Bates.—We find a better correlation between the so-called chloroform extract and the air content than there is between the Vinsol resin obtained by the methoxyl method and the air content. The heat developed in grinding seems to affect the values used in the methoxyl method a very great deal.

Mr. Duff A. Abrams.[3]—I should like to ask a question with reference to long mixing of concrete. In the A.S.T.M. specifications for ready-mixed concrete, an hour and a half mixing is permitted. I should like to ask Mr. Wuerpel what influence Vinsol resin has on concrete mixed for $1^1/_2$ hr.

Mr. Wuerpel.—The question that Mr. Abrams raised is indeed a very cogent one. We have found that ex-

[1] Chief, Clay and Silicate Products Div., National Bureau of Standards, Washington, D. C.

[2] Engineer in Charge, Central Concrete Laboratory, Corps of Engineers, U. S. Army, Mount Vernon, N. Y.

[3] Consulting Engineer, New York, N. Y.

cessive air entrainment occurred when transit-mixed concrete was used with a long time of mixing.

We made investigations on the effect of mixing time on the air entrained in mortar and found a material increase in air with continued mixing time. We have indications only, which we intend to pursue very vigorously, that the increase in air with mixing time is less with neutralized Vinsol resin than with flake Vinsol resin. This seems reasonable, when it is considered that the flake Vinsol resin is completely inert when it enters the mixer and its activity depends entirely on its ability to go into solution and neutralize or be neutralized by the readily soluble alkalies in the cement during the mixing period. With continued mixing more and more of the solution neutralization should occur with consequent additional entrainment of air. Since neutralized Vinsol resin depends on no reaction in the mixer the effect of mixing time may not be so great.

It is one of our present endeavors to perfect a revision of the air content test method using mortar which will require that the air entrained by the mortar shall be 14 plus or minus 4, or some variation of this in the regular mixing time of two minutes, and that this percentage shall not be increased by more than blank percentage after ten or perhaps twenty minutes of mixing. If successful, this might afford a further control on the entrainment of air in concrete as affected by mixing time, and I think such a procedure would be desirable because the use of transit mixing is on the increase. But it will require that we change our method of mixing mortars for testing from the manual kneading to a mechanical mixer. I think that change would be a very salutary one and I hope that it can be made. It is obviously impracticable to expect an operator to mix mortar in the standard manner for ten or twenty minutes and do it on repeated mortars all day long. It is not even desirable to depend on manual mixing for shorter periods of time.

Mr. J. C. Pearson (*Chairman*).[4]—I should like to ask whether anyone present is familiar with the latest ideas and recommendations of the National Ready-Mixed Concrete Association in regard to the delivery of concrete containing air-entraining cement in transit mixers—whether the time of mixing should be held to a minimum, and whether a closed mixer drum affects the amount of entrained air?

Mr. Wuerpel.—No, I cannot. I do know that Mr. Stanton Walker and the National Ready-Mixed Association are very actively working on the problem.

Mr. Alexander Foster, Jr.[5]—In the spring of 1943, Warner Company, in Philadelphia, was asked to serve central-mixed concrete to a Pennsylvania State Highway road job for which air-entraining cement was specified. Rumors had it that Vinsol-resin-treated-cement concrete delivered in closed, revolving, truck bodies entrained an excessive amount of air enroute, and that, possibly, the time interval, or length of haul, was involved. Not having any first-hand data on the subject, the company refused to deliver the concrete. Sand, gravel, and cement were delivered to the road job in batches and concrete was mixed at the site of the work.

In the fall of 1943, it was decided to run a series of tests to determine the action of concrete containing air-entraining cement under conditions simulating those to be found in a central-mixed-concrete plant and in revolving truck bodies enroute to the site of the work.

Inasmuch as the work to be served came under the jurisdiction of the Pennsylvania State Highway Department, all materials used in the tests met the specifications of that body. It was decided to run the tests in a laboratory equipped with a standard tilting mixer having a volumetric capacity of $13^1/_2$ cu. ft. To simulate the condition in a closed, revolving-drum type of truck body, a steel disk with rubber gasket was arranged to fit over the mixer charge-discharge opening to seal the drum hermetically. This disk or plate was arranged to be quickly applied or removed from the mixer. It was fitted with a pressure gage and a quick-coupling hose to an air compressor.

Four series of tests were run in four days. Thirty-six batches were made. One batch of standard-portland-cement concrete was made each day for the purpose of comparison with Vinsol-resin-treated cements. The other batches were made with two different brands of cement, containing different quantities of Vinsol resin and entraining greatly different percentages of air for a given quantity of ingredients, including water. Different water contents were used to obtain slumps varying from about 2 in. to 5 in. The batch was 2.7 cu. ft. for standard-cement batches of about 2-in. slump. In series Nos. 1, 2 and 4, the mix used was that specified for Pennsylvania Highway one-course pavements using gravel as the coarse aggregate. In series No. 3, proportions were varied to provide different cement contents and different consistences.

In certain cases, the drum was run as a mixer at a peripheral speed of about 175 ft. per min., and the batch discharged. Two slumps were taken, a weight determination made, and cylinders molded for strength tests at 7 and 28 days. Wet concrete was weighed in a cubic-foot measure of height approximately twice the diameter. This unit was believed to give better concordance of results than a standard A.S.T.M. container. Concrete was placed in three layers, each layer being rodded 25 to 30 times. The top of the measure was struck off with a steel plate. In other cases, after the above procedure, the concrete used in weight and slump tests was returned to the mixer and the drum tilted to obtain less efficiency of the mixing blades and revolved at a peripheral speed of about 42 ft. per min. This simulated the action in the 6-ft. diameter truck bodies which revolve at a little over 2 rpm. Slump, weight determinations and cylinders for strength tests were taken after 15 and 30 min. of mild agitation. The weights obtained varied greatly. The air entrainment varied from 3 per cent to 13 per cent depending upon the proportions of the concrete and the brand of the cement.

In some of the tests, the steel disk referred to above was bolted to the mixer drum and the batch agitated 15 min.; no differences in weight were noticed when compared with similar batches agitated 15 min. open to the air. Before the disk was removed after agitation, the valve on the disk was open. There was evidence of a small amount of pressure being built up in the case of certain of the batches. However, this pressure was too small to be registered on the gage. Two batches were mixed 2 min. and agitated in the closed drum for 15 min. under 10 psi. air pressure. Here, again, no significant change in weight resulted.

The tests were of interest and seemed to prove that there was no injury to concrete mixed in a stationary, open

[4] Director of Research, Lehigh Portland Cement Co., Allentown, Pa.
[5] Vice-President, Warner Co., Philadelphia, Pa.

mixer and transported in a slowly revolving, closed body. However, the results showed some high air entrainment, subsequently determined to be due to the quantity of Vinsol resin ground with the particular brands of cement used in the tests.

It can be said, in general, that the results from compression cylinders indicated that the loss in strength bore a definite relation to the loss in weight per unit of volume as measured by weight determinations of the plastic concrete.

In early 1944, tests were made using the standard, closed-drum truck body and the high-discharge, open-end truck body. Sixty yards of concrete were mixed, conveyed varying lengths of time, and deposited for roadways at one of the company's distributing yards. Mixing was performed in a 3-yd. Ransome stationary mixer at the concrete plant and the concrete was conveyed in 5-yd. truckloads.

Six loads with the high-discharge and six loads with the low-discharge type of bodies, each containing 5 cu. yd. of concrete, were tested over a period of two days. Of these twelve loads, two were of standard cement, for comparison with the air-entraining cement used in the remaining ten loads.

All concrete was composed of materials passing the specifications of the Pennsylvania State Highway Department. The mix was 1:1.7:3.5 (modified to compensate for an assumed air entrainment), which is used for one-course pavement where the coarse aggregate is gravel. The concrete was mixed in $2^1/_2$-cu. yd. batches for two minutes in a 3-yd. Ransome stationary mixer at the central-mixing plant. Two batches were discharged into the drum of the trucks used in delivery. These drums revolved at about 2 rpm, inducing a mild agitation of the concrete rather than a true mixing action. The different batches were hauled for periods of 25, 50, 75, or 90 min. before discharge.

The consistency of the concrete upon delivery varied between very close limits. This was true despite the necessity of adding slightly greater amounts of water at the central-plant mixer to compensate for the reduction in slump due to the longer hauling periods.

One brand of cement with a low Vinsol-resin content was used. Slump tests were made at the mixer, and slump and weight determinations were made upon delivery. The air entrainment ranged from 1.73 per cent for concrete having a 2-in. slump to 2.51 per cent concrete having a $2^3/_4$-in. slump. Standard-cement concrete having a slump of $1^1/_4$ in. entrained approximately 0.5 per cent of air.

Concrete was placed in a pavement at one of the company's distributing yards by a local paving contractor. Observation from time to time will be made to note the wear or deterioration of the concrete.

These tests indicated to us that,

1. With Pennsylvania Highway one-course-pavement mix, with a low water content, it would be safe to supply concrete made with selected air-entraining cement to jobs lying within an economic haul of the company's Philadelphia distributing yards.

2. Before a job was to be served with air-entraining type of cement concrete, it would be advisable to run batches of the proposed mix, having the desired slump, in the laboratory mixer and determine the percentage of air entrainment.

3. The air entrainment in the laboratory mixer is slightly greater than the air entrainment found in the work upon delivery by the concrete trucks. This was felt to assure the company that satisfactory results obtained in the laboratory would be satisfactory at the site of the work.

4. Administered with a proper control at the central-mixing plant and with modern agitator bodies, including the horizontal, closed-drum type and / or the high-discharge, open-end type, for delivery to the site of the work, satisfactory concrete can be delivered with a very small percentage in variation of slump, volume, and strength.

5. Warner Company should, and did, enter into contract for the servicing of several concrete highways within the City of Philadelphia. This work was in April of 1944. The results have been entirely satisfactory to the State Highway Department of Pennsylvania and the contractor.

Warner Company's procedure at present is to test by batches in the laboratory any brand of air-entraining cement to be used in a given job. A request is made that all cement for a given job be from one bin, or a series of bins containing cement with closely similar characteristics. All the work to date in which air-entraining cements have been used has been under the jurisdiction of the Pennsylvania Highway Department. The cements which are requested for this type of work, where the slumps range from 2 in. to 3 in., are those which will entrain no more than 3 per cent of air.

All the tests referred to were performed by the company's forces and under the direction of H. J. Knopel, Registered Engineer. Stanton Walker, Director of Engineering of the National Ready Mixed Concrete Association, cooperated in the outline and conduct of the tests.

Mr. Wuerpel.—I might add that when we became aware of the low strengths and high entrainment of air on one particular project, we did fear that the sealed drums, the vents which had been clogged with concrete, might be responsible for the large increase in air content. However, subsequent experience has indicated that the sealed drum is not a material factor, and I agree with Mr. Foster in that respect.

But we do find that, generally speaking, there is an increase in air content with continued mixing.

Mr. H. W. Leavitt[6] (*by letter*).—Messrs. Wuerpel and Weiner are to be congratulated on their study of "The Reaction of Vinsol Resin as It Affects the Air Entrainment of Portland Cement Concrete." Their report is based on 106 cases so that the data therein are of some statistical importance. They present four scatter diagrams in their Figs. 1 and 2. It can readily be seen that the relationship indicated by the dispersion of the dots in these scatter diagrams is quite different in each case.

The investigators have been kind enough to submit their data for the purpose of obtaining the quantitative measures of the relationships in these four diagrams. These relationships are indicated by the correlation coefficients which follow.

[6] Secretary, Maine Technology Experiment Station, University of Maine, Orono, Me.

TABLE OF RELATIONSHIPS.

	Variables	Correlation Coefficient, r	Control Indicated by r, $[100(1 - \sqrt{1 - r^2})]$, per cent
Fig. 1 (*a*)...	Air content *versus* Vinsol resin content of cement	0.128 ± 0.064	0.8
Fig. 1 (*b*)...	Air content *versus* Vinsol resin content of extract	0.826 ± 0.021	43.7
Fig. 2 (*a*)...	Alkalinity *versus* Vinsol resin content of extract	0.512 ± 0.048	14.1
Fig. 2 (*b*)...	Alkali *versus* Vinsol resin content of extract	0.448 ± 0.053	10.6

It will be noted in the table above that the relationship between air content and Vinsol resin content of cement (Fig. 1 (*a*)) is very slight as indicated by a value of r = 0.128, and a percentage control of only 0.8. The second relationship cited, namely, air content *versus* Vinsol resin content of extract (Fig. 1 (*b*)) is relatively high as indicated by a value of r = 0.826, and a percentage control of 43.7. The relationships presented in Fig. 2 are much less as indicated by the values of r and the corresponding percentages of control.

TABLE I.—MATERIALS AND MIXING PROCEDURE.

AGGREGATES:	*Fine aggregate:*	Natural, rounded, siliceous sand from Long Island, New York.
	Coarse aggregate: Gravel:	Natural, rounded siliceous gravel from Long Island, New York.
	Crushed stone:	Crushed, basaltic, trap rock from southern Connecticut.
	Maximum Size:	3/4 in.
CONCRETE MIXING:	*Mixer:*	3 1/2-S, Smith, tilting, horizontal drum.
	Mixing Procedure: Charging:	The mixer-drum was set in motion and the materials charged continuously in the following order: (1) Coarse aggregate, (2) 2/3 of mixing water, (3) Cement, (4) Fine aggregate, (5) 1/3 of mixing water.
	Mixing:	After all the materials had been added, mixing was continued for 3 min., was followed by a 1-min. rest and finally by 1 min. of remixing before discharge.

MESSRS. CHARLES E. WUERPEL AND ALBERT WEINER[7] (*authors' closure, by letter*).—It was suggested to the authors, in a private communication, that the value of the data given in Fig. 4 of the paper would have been enhanced considerably if the significant data on the concrete had been presented. These data are given in Tables I and II of this closure.

Experience gained on two large projects with cement containing neutralized Vinsol resin during the past three months has indicated that the relationship between the air entrained as determined by the mortar test (C 185 - 44 T)[8] referred to in the paper and the air entrained by concrete containing 6.0 bags of cement per cu. yd. and 2 in. maximum size crushed stone coarse aggregate is somewhat different than indicated in Fig. 4 of the paper. On these projects, the cement mortar test developed 16 and 18 per cent air and the concrete developed air contents of 3.5 and 4.0 per cent, respectively, when tested in accordance with A.S.T.M. Standard Method of Test for Yield of Concrete (C 138 - 39).[9] The ratio between the air in the mortar and in the concrete in both cases is approximately 4.6, whereas, the average ratio indicated in Fig. 4 for concrete containing stone coarse aggregate is about 2.65. This should be reassuring to those who fear the effect of air contents in excess of 4 per cent, because the cement used in both projects entrained air near the maximum amount permitted in the mortar test prescribed in A.S.T.M. Tentative Specifications for Treated Portland Cement for Concrete Pavements (C 175 - 42 T).[10]

This practical experience with cement purchased[11] recently under the A.S.T.M. Specifications C 175 has been

[7] Assistant Engineer, Central Concrete Laboratory, Corps of Engineers, U. S. Army, Mount Vernon, N. Y.

[8] Tentative Method of Test for Air Content of Portland-Cement Mortar (C 185 - 44 T), 1944 Book of A.S.T.M. Standards, Part II.

[9] 1942 Book of A.S.T.M. Standards, Part II, p. 408.

[10] *Ibid.*, p. 1055.

[11] By exception from Limitations Order L-179 granted to the Corps of Engineers by the War Production Board for use in the northeastern portion of the United States.

TABLE II.—CHARACTERISTICS OF CONCRETE MIXTURES.

Cement		Gravel Concrete					Crushed Stone Concrete				
Serial Number	Vinsol Resin Content, per cent	Water-Cement Ratio, gal. per bag	Sand as per cent of Aggregate[a]	Slump, in.	Air Content, per cent	Actual Cement Factor bbl. per cu. yd.	Water-Cement Ratio, gal. per bag	Sand as per cent of Aggregate[a]	Slump, in.	Air Content, per cent	Actual Cement Factor bbl. per cu. yd.
RC-97	0.000	6.0	38	2.2	1.3	5.38	7.10	44.5	2.25	2.5	5.30
RC-99	0.009[c]	5.60	33	2.4	3.6	5.27	6.48	37.5	3.0	5.1	5.18
RC-117	0.017[c]	5.44	33	2.9	6.4	5.13	6.17	36.5	3.2	8.0	5.05
RC-98	0.030	5.60	33	2.3	4.3	5.23	6.55	37.5	3.2	6.3	5.13
RC-101	0.000	6.0	38	2.25	2.0	5.35	7.10	44.5	2.0	2.1	5.37
RC-103	0.009[c]	5.60	33	2.0	4.0	5.25	6.52	37.5	3.0	4.8	5.19
RC-118	0.019[c]	5.52	33	2.25	5.6	5.16	6.23	36.5	2.6	7.3	5.08
RC-102	0.029	5.50	33	2.2	5.1	5.18	6.45	37.5	2.6	4.7	5.20
RC-105	0.000	6.0	38	2.5	2.8	5.32	7.10	44.5	2.8	4.1	5.23
RC-107	0.008[c]	5.47	33	1.9	4.7	5.21	5.97	37.5	1.75	5.7	5.15
RC-119	0.013[c]	5.27	33	1.9	6.5	5.11	5.80	36.5	2.25	9.0	5.01
RC-106	0.028	5.35	33	2.9	10.0	4.95	6.00	37.5	3.7	14.1	4.78
RC-109	0.000	6.20	38	2.7	1.5	5.37	7.25	44.5	2.9	2.7	5.30
RC-111	0.010[c]	5.70	33	2.9	4.9	5.20	6.40	36.5	3.0	4.9	5.20
RC-120	0.020[c]	5.45	33	2.8	7.5	5.07	6.00	36.5	3.1	9.8	4.97
RC-110	0.028	5.75	33	3.1	4.3	5.22	6.60	37.5	2.75	4.8	5.20
RC-113[b]	0.000	6.20	38	1.9	2.0	5.33	7.25	44.5	2.3	2.8	5.29
RC-115[b]	0.012[c]	5.67	33	2.1	4.9	5.20	6.37	36.5	2.7	6.4	5.12
RC-121[b]	0.020[c]	5.42	33	2.0	7.0	5.10	6.10	36.5	2.6	9.6	5.00
RC-114[b]	0.030	5.70	33	2.7	5.5	5.17	6.50	37.5	2.9	6.3	5.12

[a] Per cent by weight.

[b] Type I cement; all others are in type II, as designated in the A.S.T.M. Standard Specifications for Portland Cement (C 150 - 42), 1942 Book of A.S.T.M. Standards, Part I, p. 1.

[c] Vinsol resin added as sodium resinate (neutralized Vinsol resin).

most encouraging. The air content of the concrete has been very consistent; varying remarkably little from the average values shown above.

The authors are grateful to Mr. Leavitt for the statistical analysis of the scatter diagrams in Figs. 1 and 2 of the paper.

A surprisingly large proportion of the discussion of the paper dealt with ready-mix concrete. It is not believed well to create a new subject as a part of a closure to this paper, despite the high current interest in that subject. However, it will be said that the observations made of ready-mix concrete operations on Corps of Engineer projects during the past several years lead the authors to support and encourage the policy adopted by the Warner Company as set forth by Mr. Foster. The difficulties encountered in work with which we are familiar have arisen principally when the concrete has been *mixed-in-transit* for periods of time varying from 10 to 25 minutes. Even these difficulties are believed now to have been caused largely by (1) transit mixers with badly worn blades, (2) erratic water control, (3) overloading, and (4) inexpert operation. Most of those faults were direct results of the scarcity of new equipment, poor maintenance facilities, and shortage of trained personnel coincident with the war emergency.

As stated by the senior author, in discussion from the floor, venting of closed drum mixers was found not to be a material factor in air entrainment after this possibility which suggested itself from the results obtained on one project had been investigated more fully. However, the general evidence gathered from numerous projects on which transit mixers were used is that the loading and operation of most transit mixers at the rated capacity of 57.5 per cent of the drum volume will result in increased air entrainment with increasing mixing time. This tendency is much less noticeable when the load in the drum is limited to 40 per cent of the drum volume. Transit mixers loaded to this reduced volume and operated at mixing speed for five minutes develop air contents comparable with paving mixers. This subject will be presented in greater detail in a Second Interim Report on Concrete Research now in preparation in this laboratory.

New Technical Committee G on Lubricating Grease

A New Technical Committee G on Lubricating Grease has been authorized by A.S.T.M. Committee D-2 on Petroleum Products and Lubricants. This has been done to increase the scale of the committee's activity on the important subject of lubricating greases, conducted previously by a subcommittee, and at the same time to make it cover a wider field including the development of product specifications. Officers of this new committee are: F. L. Wright (Chairman), Norma-Hoffman Bearings Corp.; C. W. Georgi (Vice-Chairman), Enterprise Oil Co.; and H. A. McConville (Secretary), General Electric Co., Schenectady, N. Y.

Scope:

At a meeting of the officers held to outline the work of Technical Committee G, it was tentatively agreed that the present scope of the committee's work be confined to lubricating greases, principally those nonfluid at room temperature, and excluding gear oils, waxes, petrolatums, or rust-preventive compounds. The development of closer cooperation between existing groups now working on lubricating greases and Technical Committee G is an important objective.

Objectives:

The objectives of the committee's work were outlined as follows:

1. To encourage and stimulate the interest of consumers and organized consumer groups in the problems relating to chemical, physical, and functional tests for lubricating grease, to performance in service.
2. To develop cooperation between existing technical groups now working on lubricating greases and A.S.T.M. Technical Committee G, and to correlate the work and activities of these respective groups.
3. To examine and review existing lubricating grease test methods for the purpose of developing modifications or improvements where such are indicated to be desirable.
4. To examine and develop new lubricating grease test methods where such are indicated to be desirable.
5. To evaluate and define the scope, significance, and limitations of existing test methods and of any new methods which may be developed.
6. To establish the relationship of data supplied by tests methods to performance under well-defined service conditions.

It is planned to hold the first session of this new Technical Committee G at the time of the regular 1945 January meetings of A.S.T.M. Committee D-2. At that time two papers are to be presented. The first will be entitled "Past History of Lubricating Grease Test Methods" by H. A. McConville; the second paper entitled "Activities of Industry Cooperating Committees Working on Test Methods for Lubricating Grease," will be presented by T. G. Roehner. Ample time will be provided for a general discussion of these two papers and also for presentation of ideas on how best to reach the objectives set up for this committee's work.

Joint Committee with Paint and Varnish Production Clubs

As a result of a recent conference between representatives of the Society and the Federation of Paint and Varnish Production Clubs, a joint committee of the two bodies has been established to further cooperation between them in activities involving the development of standard methods of test and specifications in the paint and allied fields. While many members of A.S.T.M. Committee D-1 on Paint, Varnish, Lacquer, and Related Products are also active in the various Production Clubs, the new joint committee will formalize the contacts between the two, and it is anticipated that committees or groups working in each organization on related problems will coordinate their activities through the joint committee.

The joint group will be expected to review methods of test which have been developed and submit recommendations to the two organizations. Members of the committee representing the Society have been nominated by A.S.T.M. Committee D-1 as follows: R. D. Bonney, H. W. Nelson, and C. H. Rose; representatives from the Federation are P. O. Blackmore, K. H. Howe, and R. W. Matlack.

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Distinguished Service Award

As PRESIDENT Bates said in his acceptance for the Society of the Ordnance Distinguished Service Award, the entire membership joined him in expressing deep appreciation. Both he and General Barnes enumerated materials and activities where the Society and its technical committees had effectively aided in the production and procurement of Ordnance matériel. Two things come to mind in connection with this award, one a series of articles prepared by the late Cloyd M. Chapman during his incumbency as president when he explored in pithy articles the questions "what," "why," "when," and "who" is A.S.T.M. His concluding sentence on the question of "Who," of course, was "The Society is you." And that is why each member can feel he has had a part in getting the results that helped the Ordnance Department.

Obviously with such a great diversity of technical activities there must always be in peace or war some ingredient or catalyst to provide constant progress. Perhaps the real basis for the acclaim which the technical world has given the Society is the very democratic cooperation evident in all our work. Perhaps also the technical freedom which Mr. Burns discusses in his introduction to the new Symposium on Plastics is part of the answer. Certainly the accomplishments of the Society in aiding production of war material whether for the Army, Navy or industry justify the way in which the Society operates.

Attendance at District Meetings

MANY OF THE MEMBERS, especially those in industrial centers where A.S.T.M. District Committees have been organized, will be interested in various meetings being scheduled during the fall and winter months by the respective district groups. News of these meetings appears in the BULLETINS and usually a notice is mailed directly to each of the A.S.T.M. members and committee people in the respective districts.

Basically, the fundamental purpose of a District Committee is to foster the advancement of the Society and its work and many of the committees have found technical meetings effective toward this end.

The number of meetings held and the nature of the program depend largely on local factors, but in almost every case the papers and discussions presented are of interest not only to those concerned with the specific subject, but are broadly educational and will repay the attendance of any materials engineer. The discussion on life testing to be held in Detroit in November and the Symposium on Magnetic Particle Testing Methods scheduled for Philadelphia in January are typical programs of the more extensive type.

Frequently many of the talks are published—for example, the Symposium on Plastics just off press, arranged by the Philadelphia District early this year. With careful planning the meetings can bring out new technical data and effectively provide desirable summaries of existing knowledge. But the meetings have one other most important attribute—they provide all of our members in a particular locality with an opportunity of rubbing elbows with other members, meeting new members, and in this way overcome somewhat the fact that A.S.T.M. does not have local sections with regular, periodic get-togethers.

Every member who can is urged to attend these district meetings.

Papers and Papers of Merit

VERY LIKELY the action of the 1944 Dudley Medal Committee in *not* making an award for a paper of outstanding merit presented during the past year, constituting an original contribution on research, was a surprise to many. Possibly some have glanced rather carefully through the *Proceedings* and the issues of the BULLETIN to satisfy themselves that the decision of the committee was a proper one. Others may have registered only surprise or at most mild concern over the fact that the quality of the papers or the research involved apparently were not of a caliber sufficient to justify the award.

It is hoped that the action will have the effect of leading prospective authors to give more thought and care to preparing their papers. Many authors have at hand most valuable data. But their main interest in their work has been in obtaining the data. Putting it into proper shape for printing is such a decided bore that the material is hastily thrown together, poorly discussed and inadequate and improper conclusions presented. Other authors have more carefully prepared what they have—but unfortunately did not have much. Still others have material of but slight novelty and have also but little ability in preparing papers. Such conditions do not tend to enhance the standards of technical literature. Incidentally why are technical and in general all scientific publications referred to as "literature" when a rather large percentage of it can hardly be so characterized.

Whether the papers subjected to the last review exhibited all or some of the above faults is not evident to me. To be candid I have read but a small percentage of them and even these were read in far from a critical manner. But it must be acknowledged that the conditions under which all of us have been working for some time have not been such as to lead to painstaking planning of work or equally painstaking careful presentation of the results.

Undoubtedly during the past couple of years a great

deal of work has been done which though possibly hastily and not too thoroughly done would with a little expansion and touching up yield original data well worth publication. It is earnestly hoped this will be brought forward. While it is not suggested that authors prepare their material solely with the award in mind, it would not be amiss if they kept the award in mind sufficiently to prepare their material toward the level of an award standard.

The action of the 1944 Dudley Award Committee should be highly complimented if it is provocative of more careful preparation of papers in the future. On the other hand, it would be very regrettable if the action resulted in a hesitancy on the part of authors to publish. Such should not be the case if technical authors would remember that the reason for publishing is the imparting of information, and particularly novel information, to readers. Hence they should first be sure that they have such information. Then they should correctly, adequately (as to size but no more than adequately), and understandingly do the imparting. This is not a too difficult task. Indeed at times, if well and carefully done, the task becomes instructive to the authors. They frequently learn much about their own work in preparing it properly for imparting to others.

P. H. Bates

PRESIDENT

Schedule of A.S.T.M. Meetings

DATE	COMMITTEE	PLACE
October 24, 25	D-9 on Electrical Insulating Materials	Claridge Hotel Atlantic City, N. J.
October 26, 27	D-20 on Plastics	Claridge Hotel Atlantic City, N. J.
October 31	E-6 on Papers and Publications	Headquarters Philadelphia, Pa.
November 22	Detroit District—"Life Testing"	Detroit, Mich.
November 29, 30, December 1	A.S.T.M.-A.I.M.E. Symposium on Season Cracking	Benjamin Franklin Hotel Philadelphia, Pa.
January 17	New York District—Petroleum and Its Modern Derivatives	Engineering Societies Bldg., New York, N. Y.
January 22	Philadelphia District—Symposium on Magnetic Particle Testing	Benjamin Franklin Hotel Philadelphia, Pa.

Favorable 1944 Standards Letter Ballot

A CANVASS on September 15 of the 1944 letter ballot on recommendations affecting A.S.T.M. standards showed all items on the ballot adopted. There were 181 actions covered, 103 revisions of existing standards were adopted for incorporation this year, and 78 previously existing tentative standards were adopted as formal standards. Over 425 votes were cast and while in accordance with previous practice no record of the returns will be published, any member of the Society who wishes to have the vote on a particular item can obtain this information from A.S.T.M. Headquarters.

All of the new and revised standards will appear in the 1944 Book of A.S.T.M. Standards. In some cases previous to the appearance of the books separate reprints of the specifications and tests will be available and a number of them will be incorporated in special compilations of standards which are described in a new pamphlet, "List of Publications" and "Members' Order Blank" which will be sent to members shortly.

Carter S. Cole Joins A.S.T.M. Staff

WE ARE INDEED pleased to announce the addition to the headquarters technical staff of Mr. Carter S. Cole. This addition is the first step taken toward amplifying the Headquarters staff in such a way as to maintain closer contacts with our standing committees, a need that has been felt for some time. Mr. Cole will be in a position to meet with the standing committees and their officers and in other ways to establish closer liaison between Headquarters and the committees. He will devote his activities primarily to the metals field.

Mr. Cole's experience has been largely in the non-ferrous metals field. He comes to us from an assignment with the War Production Board where for the past year he has been Chief of the Metals Branch of the Conservation Division. He joined the staff of that Division on January 7, 1942, as consultant on non-ferrous metals in the Specifications Branch.

Prior to that time, Mr. Cole was Engineer on the staff of the Copper & Brass Research Assn. in New York with which he had been associated for some fifteen years. Previous to that he had worked in the Motive Power Department of the Pennsylvania Railroad. He served in the Navy during the last World War and is a graduate of the University of Virginia, class of 1917.

He is a member of A.S.M.E., A.I.M.E., S.A.E., and the Institute of Metals (London), as well as of A.S.T.M., having been active in the work of the Society's Committee B-5 on Copper and Copper Alloys, Cast and Wrought for a number of years.

Marburg Lecture Committee

THE COMMITTEE which will select the Edgar Marburg Lecturer for 1945 has been appointed. Under the rules governing the lecture, this group consists of a member of the Executive Committee, a member of Committee E-9 on Research, and a member of Committee E-6 on Papers and Publications. The personnel, representing the respective committees in the order named, is as follows: Past-President Dean Harvey, Materials Engineer, Engineering Laboratories and Standards Department, Westinghouse

Officers of Committee A-2 on Wrought Iron. From left to right, C. B. Bryant, Chairman; D. M. Stembel, Vice-Chairman; and James Aston, Secretary.

Electric and Manufacturing Co., East Pittsburgh, Pa.; O. E. Harder, Assistant Director, Battelle Memorial Institute, Columbus, Ohio; and L. M. Currie, Research Laboratories, National Carbon Co., Cleveland, Ohio. Mr. Harvey is serving as chairman.

Committee C-8 on Refractories Meets

DURING THE war period, Committee C-8 on Refractories in order to conserve as much as possible the time of its members has scheduled only one formal meeting each year. The 1944 meeting was held at the Mellon Institute in Pittsburgh on September 28. A very considerable amount of business was transacted which had to do with the revision of specifications and test methods and

Officers of Committee A-7 on Malleable-Iron Castings. From left to right, C. O. Burgess, Chairman; W. A. Kennedy, Vice-Chairman; and H. A. Schwartz, Secretary.

proposals for elevation of tentative standards to standard. Industrial surveys relating to the use of refractories in various industries are an important part of the Committee C-8 Manual on Refractories. Three of these surveys are being revised, and two new ones are planned.

Discussion was devoted to the committee's method of determining the thermal conductivity of insulating fire brick, which led to the recommendation of adopting a general test method covering a revised apparatus and general procedure for testing. This will be supplemented by separate methods of test giving details for the procedure as relating to refractories and insulating fire brick.

Approval was given for definitions for air-setting refractory mortar and fireclay plastic refractories. A new Subcommittee on Microscopy was established, and the scope of Committee C-8 work was broadened by appointing a subcommittee pertaining to Special Refractories.

Officers of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. From left to right, H. S. Rawdon, Chairman; R. W. Waring, Vice-Chairman; and A. W. Tracy, Secretary.

Officers of Committee C-9 on Concrete and Concrete Aggregates. From left to right, F. E. Richart, Chairman; K. B. Woods, Vice-Chairman; and Stanton Walker, Secretary.

Officers of Committee A-5 on Corrosion of Iron and Steel. From left to right, C. D. Hocker, Chairman; R. F. Passano, First Vice-Chairman; T. R. Galloway, Second Vice-Chairman; and J. B. Dixon, Secretary.

Joint Meeting on Stress-Corrosion Cracking

Symposium with 30 Technical Papers Features Philadelphia Session November 29–December 1.

A THREE-DAY meeting of widespread interest to all ferrous and non-ferrous metallurgists and those concerned with stress-corrosion cracking is being held in Philadelphia from November 29 through December 1 under the joint sponsorship of the Society and the American Institute of Mining and Metallurgical Engineers. This features a symposium with some 30 technical papers to be presented in eight sessions as outlined below. One of the meeting features on the evening of November 29 is an informal dinner and technical session being sponsored by the local A.S.T.M. and A.I.M.E. groups. This program will include an address by Mr. Ralph Kelly, President, The Baldwin Locomotive Works, and a technical paper providing critical discussion of this whole field of stress-corrosion cracking by E. H. Dix, Jr., Assistant Director of Research and Chief Metallurgist, Aluminum Company of America. All sessions are at the Benjamin Franklin Hotel.

Plans for the Symposium were started at the instigation of Lt. Col. C. H. Greenall, Frankford Arsenal, who was then Chairman of A.S.T.M. Committee B-5 on Copper and Copper Alloys, Cast and Wrought. The first meeting of the planning committee was held on March 1 in Cincinnati during the A.S.T.M. Spring Meeting. The plans have since been developed by this committee, the personnel of which represents the joint A.S.T.M. and A.I.M.E. interests. The members include Messrs. E. A. Anderson and Carter S. Cole, serving as co-chairmen, E. H. Dix, C. H. Greenall, H. S. Rawdon, and L. L. Wyman. R. E. Hess, Assistant Secretary, A.S.T.M., F. T. Sisco, Secretary of the Institute of Metals Division, A.I.M.E., and G. H. Harnden, present chairman of A.S.T.M. Committee B-5 are ex-officio members.

The Symposium has taken on an international aspect with two papers contributed from England—one on behalf of the Institute of Metals and the other on behalf of the Iron and Steel Institute. Stress-corrosion cracking is a very active subject at this time and much information has been added to our field of knowledge during the war, not only on the subject of brasses and other copper alloys, but also the occurrence of this phenomenon in other metals, such as steels, and aluminum and magnesium alloys, all of which are to be covered in the Symposium.

Symposium on Stress-Corrosion Cracking

The Benjamin Franklin, Philadelphia

Wednesday, November 29

Morning Session on Brass—9.30 a.m.

Ammonia and Mercury Stress-Cracking Tests for Brass—Gerald Edmunds E. A. Anderson, and R. K. Waring, The New Jersey Zinc Co. (of Pa.).
Stress-Corrosion Testing of Copper Base Alloys—C. L. Bulow, Bridgeport Brass Co.
The Aqua Ammonia Test—A. L. Jamieson and H. Rosenthal, Frankford Arsenal.
The Role of Smokeless Powder in the Season Cracking of Small Arms Ammunition—J. W. Mitchell, Frankford Arsenal.

Afternoon Session on Brass—2 p.m.

Season Cracking of Brass—Gerald Edmunds, The New Jersey Zinc Co. (of Pa.).
Mechanism of Season Cracking of Brass—T. A. Read, J. Reed, and H. Rosenthal, Frankford Arsenal.
Residual Stress in Caliber 0.30 Cartridge Cases—H. Rosenthal and J. Mazia, Frankford Arsenal.
Sonic Testing for Cracks—T. A. Read, H. I. Fusfield, and S. W. Kitchen, Frankford Arsenal.

Evening—Dinner and Technical Session—6.30 p.m.

Dinner sponsored by the A.S.T.M. Philadelphia District Committee and the Philadelphia A.I.M.E. Section.
Address by: Ralph Kelly, President, The Baldwin Locomotive Works. Followed by a technical paper on Stress-Corrosion Cracking—E. H. Dix, Jr., Assistant Director of Research and Chief Metallurgist, Aluminum Company of America.

Thursday, November 30

Morning Session on Brass—9.30 a.m.

Stress-Corrosion Properties of Some Non-Ferrous Sheet Metals—G. R. Gohn and S. M. Arnold, Bell Telephone Laboratories, Inc.
Effect on Season Cracking of Alloy Additions to Cartridge Brass—T. C. Wilson, Gerald Edmunds, E. A. Anderson, and W. M. Peirce, The New Jersey Zinc Co. (of Pa.).
Protective Resin Films on Cartridge Brass—H. Gisser, Frankford Arsenal.
Factors Influencing the Stress Cracking of Brass Cartridge Cases—George Sachs, George Espey, Case School of Applied Science, and S. M. Clark, Thompson Aircraft Products Co.

Afternoon Session on Light Metals—2 p.m.

Test Methods and Progress in the Stress-Corrosion Investigation at Wright Field—Baxter C. Madden, Jr., U. S. Army, Wright Field Dayton, Ohio.
Accelerated Tests for Susceptibility to Stress-Corrosion Cracking—G. F. Sager, R. H. Brown, and R. B. Mears, Aluminum Company of America.
Stress-Corrosion Testing of Magnesium Alloys—W. S. Loose, The Dow Chemical Co.
The Assessment of the Susceptibility of Aluminum Alloys to Stress Corrosion—F. A. Champion, The Institute of Metals, and British Aluminium Company, Ltd. (England).

Evening Session on Light Metals—8 p.m.

Discussion of Stress Corrosion—Hiram Brown, Frontier Bronze Corp.
Stress Corrosion in Relation to Aircraft Components—C. W. George, and Bruce Chalmers, British Iron and Steel Institute (England).
A Generalized Theory of the Stress Corrosion of Alloys—R. B. Mears, R. H. Brown, and E. H. Dix, Jr., Aluminum Company of America.

Friday, December 1

Morning Session on Steel—9.30 a.m.

Elevated Temperature Tests on Galvanized Steels—J. H. Craig, The New Jersey Zinc Co.
Some Observations of Stress-Corrosion Cracking in Austenitic Stainless Alloys—M. A. Scheil, A. O. Smith Corp.
The Susceptibility of Austenitic Stainless Steels to Stress-Corrosion Cracking—Russell Franks, W. O. Binder, and Charles M. Brown, Union Carbide and Carbon Research Laboratories, Inc.
Stress-Corrosion Cracking in Stainless Steel—O. B. Ellis, The American Rolling Mill Co.

Afternoon Session on Misc. Metals—2 p.m.

Stress-Corrosion Tests of Bridge-Cable Wire—R. E. Pollard, National Bureau of Standards.
Corrosion Cracking of Nickel Alloys by Mercury and Mercury Salts—O. B. J. Fraser, The International Nickel Co.
The Effect of a Coating of Polybutene on the Fatigue Properties of Lead Alloys—Lawrence Ferguson and George M. Bouton, Bell Telephone Laboratories, Inc.
Summary—Symposium on Stress-Corrosion Cracking—E. A. Anderson, The New Jersey Zinc Co. (of Pa.).

Preprints of most papers will be available for distribution at the meeting and also for advance distribution on request to those who plan to prepare written discussion and those who send in advance registration.

Symposium on Magnetic Particle Testing

The Philadelphia District Committee is planning a comprehensive symposium on the subject of magnetic particle testing and inspection to be held on January 22 in the Ball Room of the Benjamin Franklin Hotel. This meeting will be an important one, and foremost authorities in the field of magnetic particle testing will discuss specific phases of the subject, namely, specifications and procedure, application to various products such as castings, forgings, weldments, plate and related products, aircraft materials, etc. Further details of this meeting and abstracts will appear in the December Bulletin.

Pittsburgh District Meeting on Cement and Glass

At a meeting on Thursday evening, October 26, in the Mellon Institute Auditorium, Pittsburgh, President P. H. Bates, Chief, Clay and Silicate Products Div., National Bureau of Standards, is to speak on "Portland Cement and the Distinctive Characteristics of the Five Different Standardized Types" and F. C. Flint, Chief Chemist and Director of Research, Hazel-Atlas Glass Co., Washington, Pa., will give a talk on "Glass—A Summary of Its Development as an Art and as a Science." This meeting is sponsored by the Pittsburgh District Committee under the Chairmanship of Thomas Spooner with P. G. McVetty, Secretary, both of Westinghouse Electric and Manufacturing Co.

A cordial invitation to attend the meeting is extended to all A.S.T.M. members and committee people, and others interested. Invitations have been sent to members of other local groups in the Pittsburgh area.

Mr. Bates will give a concise picture of the development, requirements, and applications of cement and concrete with a look into the future. There are always interesting developments in this widely used material—currently air-entrainment and additions are to the fore. Mr. Flint, an authority in his field, will cover a history of the art and its slow development through the ages with its final engineering improvement and recent new fields of usefulness resulting from the more fundamental knowledge of its chemistry and physics. Widespread applications of glass products, developments of the past year or two, and the possibilities in the future make this a live subject for every technical man.

Southern California Meeting on High Strength Aluminum Alloys

The meeting sponsored by the A.S.T.M. Southern California District Committee on Wednesday evening, September 27, was most interesting and well attended, with 150 members of the Society and guests present to hear an address by Dr. E. H. Dix, Jr., Assistant Director of Research and Chief Metallurgist, Aluminum Research Laboratories of the Aluminum Company of America, New Kensington, Pa. Dr. Dix discussed the subject "New High Strength Aluminum Alloys for Aircraft." The meeting was held in the Rainbow Room of the Mayfair Hotel in Los Angeles.

The speaker was in good form and the meeting was intensely interesting. An exceptionally large number of questions by experts in both the production and metallurgical departments of the numerous aircraft companies in Southern California added materially to the interest of the evening. Dr. Donald S. Clark, metallurgist of the California Institute of Technology, was master of ceremonies for this portion of the evening meeting and kept the discussion well in hand.

The Southern California District Committee feel themselves particularly fortunate in having had an opportunity to hear this eminent metallurgist and to be able to ply him with questions. The meeting was under the general direction of the new Chairman of the District, Mr. E. O. Slater. Cooperating in various aspects of the meeting were a number of other district committee members.

Detroit Meeting in November to Cover Life Testing of Materials

The Detroit District Committee is planning a meeting, definitely scheduled for November 21, at which three outstanding authorities in their respective fields will discuss the life testing of materials. The topics to be covered and the authorities who will participate are as follows:

- The Fatigue Testing of Tire Cords—W. E. Roseveare, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
- The Life Testing of Metals—R. E. Peterson, Mechanical Div., Westinghouse Research Laboratories, East Pittsburgh, Pa.
- The Life Testing of Oil—H. C. Mougey, General Motors Research Laboratories, Detroit, Mich.

Definite confirmation of the meeting date has been announced, and full details will be furnished all members in the Detroit District. Members in other areas concerned with this interesting program are cordially invited to attend.

Mr. V. M. Darsey, Parker Rust-Proof Co., 2177 E. Milwaukee Ave., Detroit 11, who has been very active in Detroit district affairs has been elected Secretary of the committee to succeed J. W. Kennedy who died soon after he had assumed this office. Mr. Martin Castricum, Chairman of the District Committee, has been active in arranging the program and other District members will aid in meeting activities. A dinner is expected to precede the technical session which is to be in the Detroit Engineering Rooms in the Rackham Engineering Building.

Philadelphia Meeting on Hardenability of Steel

SOME 250 MEMBERS of the Society in the Philadelphia District and guests heard three interesting talks on Hardenability Bands for Steel at the meeting on October 12, following the Society's special meeting to receive the Ordnance Award. Joseph Field of Bethlehem Steel discussed "Calculated Jominy Hardenability;" Luther C. Boyd of Carnegie-Illinois Steel Corp. described "The Development of Hardenability Bands" for several series of steels; and A. L. Boegehold of General Motors Corp. covered "The Selection of Automotive Steel on the Basis of Hardenability." It is planned to include abstracts of these talks in the December BULLETIN.

Chairman L. E. Ekholm of the Philadelphia District Committee introduced Technical Chairman E. K. Spring of Henry Disston and Sons, Inc., who had developed the program and he introduced the speakers. Other members of the District Committee participated in the arrangements, in particular E. J. Albert, Thwing-Albert Instrument Co., who handled details of the dinner preceding the meetings.

Meeting of Committee B-4 on Electrical-Resistance Alloys

ABOUT 30 members of Committee B-4 on Electrical-Heating, Electrical-Resistance and Electric-Furnace Alloys attended a two-day meeting of the committee and four of its subcommittees held at the Park Central Hotel in New York City, October 5 and 6. The section on electrical parts of Subcommittee III of Committee B-9 on Metal Powders and Metal Powder Products also held a meeting in connection with the Committee B-4 meetings on October 6th.

Dean Harvey, Westinghouse Electric and Manufacturing Co., Chairman of Committee B-4, and F. E. Bash, Driver-Harris Co., Secretary of the committee, received the reports of the subcommittees at the main meeting on the 6th.

J. W. Harsch, Chairman of Subcommittee V on Wrought and Cast Alloys for High-Temperature Use, reported the tentative specification for castings of a composition of 25 chromium-12 nickel-balance iron as modified at the June meeting had been approved by his subcommittee and were ready for main committee ballot. A new specification for 35 chromium-15 nickel-balance iron, castings had

St. Louis District Officers—Herman von Schrenk, Chairman; L. A. Wagner, Secretary; E. J. Russell, Vice-Chairman.

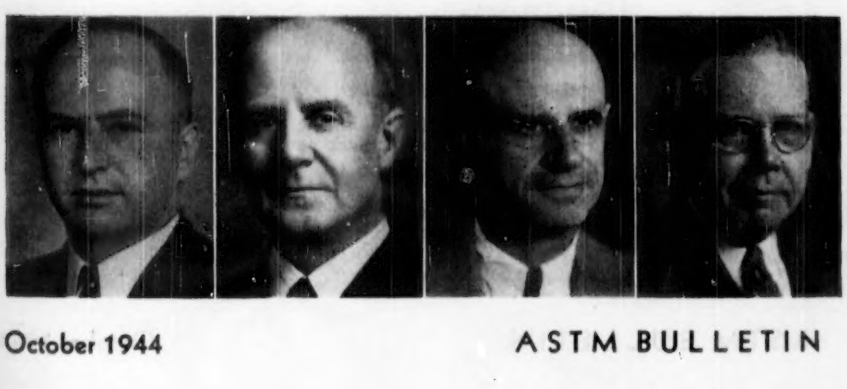
been drafted in preliminary form and a special study group had been set up to study relationship between creep strength and magnetic permeability in alloys of the type covered by these two specifications.

P. H. Brace reported that Subcommittee VII on Thermostat Metals is studying methods of test for the elastic properties of alloy spring materials at high temperature.

S. A. Standing of Subcommittee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps reported that his subcommittee is working actively on the study of particle size, on detecting flaws in tungsten wire, on methods of measuring wire of 0.002 in. diameter and smaller, on methods of test for brittleness of butt welds in lamp wires, and on the elongation of fine wires.

F. E. Carter, Chairman of Subcommittee X, reported that Section A under B. W. Jones is continuing studies on Life Tests and Section B under H. C. Graves, Jr., its studies on Load Carrying Capacity of Contacts; Section C under A. B. Gibson is tabulating information received in answer to its questionnaire on contact sizes, etc. E. I. Shobert of Section E reported 150 new references to be added as a Supplement to the B-4 Bibliography and Abstracts on Electrical Contacts.

New York District Officers—M. P. Davis, Chairman; G. O. Hiers, Secretary; E. A. Snyder, Vice-Chairman.



Western New York-Ontario District Officers—B. L. McCarthy, Chairman; O. W. Ellis, Vice Chairman; I. C. Matthews, Vice Chairman; T. L. Mayer, Secretary.

EA - A 158a

Issued August 28, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Tentative Specifications for Seamless Alloy-Steel Pipe for Service at Temperatures from 750 to 1100 F. (A 158 - 44 T) and affect only the requirements referred to:

Section 1 (b).—Change the second sentence from its present form to read as follows:

Eight grades are covered, including five ferritic steels and three austenitic steels, designated P 5a, P 11, etc. (Note 1).

Note 1.—Add at the end of Note 1 the following sentence referring to the eleven grades of material normally covered:

During the Emergency the committee in charge of these specifications recommends that production be concentrated on the five emergency grades of ferritic steel and the three emergency grades of austenitic steels.

Table 1.—Change that portion of this table of chemical requirements which relates to ferritic steels to read as follows by the omission of ferritic steel grades P 3a, P 3b, P 5b, P 6, and P 15; and revision of grades P 5a, P 5c, and P 11; and the addition of grades P 16 and P 17. Change that portion which relates to austenitic steels by revision of Grades P 8a and P 8b and addition of Grade P 8d.

TABLE I.—CHEMICAL REQUIREMENTS.

Type	Ferritic Steels		
Identification Symbol	P 5a	P 5c	P 11
Grade	4 to 6 per cent Chromium	4 to 6 per cent Chromium-Molybdenum, Stabilized with Titanium or Columbium	Chromium-Molybdenum
Carbon, max., per cent	0.15	0.12	0.15
Manganese, per cent	0.30 to 0.60	0.30 to 0.60	0.30 to 0.60
Phosphorus, max., per cent	0.04	0.04	0.04
Sulfur, max., per cent	0.04	0.04	0.04
Silicon, per cent	0.50 max.	0.50 max.	0.50 to 1.00
Chromium, per cent	4.00 to 5.50	4.00 to 5.50	1.00 to 1.50
Molybdenum, per cent	0.40 to 0.55	0.40 to 0.55	0.40 to 0.55
Titanium	.....	[a]	.....

[a] Type P 5c shall have a titanium content of not less than four times the carbon content and not more than 0.70 per cent.

Type	Ferritic Steels	
Identification Symbol	P 16	P 17
Grade	7 per cent Chromium	9 per cent Chromium
Carbon, max., per cent	0.15	0.15
Manganese, per cent	0.30 to 0.60	0.30 to 0.60
Phosphorus, max., per cent	0.04	0.04
Sulfur, max., per cent	0.04	0.04
Silicon, per cent	0.50 to 1.00	0.50 to 1.00
Chromium, per cent	6.00 to 7.50	8.00 to 9.50
Molybdenum, per cent	0.40 to 0.55	0.80 to 0.95
Titanium	....	....

Type	Austenitic Steels		
Identification Symbol	P 8a	P 8b[d]	P 8d[d]
Grade	18 Chromium 8 Nickel	18 Chromium 10 Nickel Stabilized with Titanium	18 Chromium 10 Nickel Stabilized with Columbium
Carbon, max., per cent	0.08	0.10	0.10
Manganese, max., per cent	2.00	2.00	2.00
Phosphorus, max., per cent	0.04	0.04	0.04
Sulfur, max., per cent	0.04	0.04	0.04
Silicon, max., per cent	1.00	1.00	1.00
Nickel, per cent	8.00 to 10.00[e]	8.00 to 12.00[e]	8.00 to 12.00[e]
Chromium, per cent	18.00 to 20.00	17.00 to 19.00	17.00 to 19.00
Molybdenum, per cent	....	....	....
Titanium, per cent	....	[b]	....
Columbium, per cent	....	....	[c]

[b] Grade P 8b shall have a titanium content of not less than four times the carbon content and not more than 0.60 per cent.

[c] Grade P 8d shall have a columbium content of not less than eight times the carbon content and not more than 1.00 per cent.

[d] The two emergency grades P 8b and P 8d stem from the regular grade P 8b which could be stabilized with either titanium or columbium. This regular grade is now divided into grades P 8b and P 8d covering the use of titanium and columbium, respectively.

[e] If deemed necessary by the pipe manufacturer to obtain good piercing properties, the maximum nickel content of P 8a may be increased to 11.00 per cent and of either P 8b or P 8d to 13.00 per cent.

EA - A 213a

Issued, August 28, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for Seamless Alloy-Steel Boiler and Superheater Tubes (A 213 - 42) and affect only the requirements referred to:

Table I.—Change this table of chemical requirements to read as follows by the omission of ferritic steel grades T3, T12, T13, T14, and T17, the revision of grades T5, T11, T16, T21, and T22, and the addition of grades T7 and T9:

TABLE I.—CHEMICAL REQUIREMENTS OF FERRITIC STEEL

Identification Symbol	T5	T11	T16[a]
Grade	Chromium-Molybdenum	Chromium-Silicon-Molybdenum	Chromium-Molybdenum-Titanium
Carbon, max. per cent	0.15	0.15	0.12 max.
Manganese, per cent	0.30 to 0.60	0.30 to 0.60	0.30 to 0.60
Phosphorus, max. per cent	0.04	0.04	0.04
Sulfur, max., per cent	0.04	0.04	0.04
Silicon, per cent	0.50 max.	0.50 to 1.00	0.50 max.
Chromium, per cent	4.00 to 5.50	1.00 to 1.50	4.00 to 5.50
Molybdenum, per cent	0.40 to 0.55	0.40 to 0.55	0.40 to 0.55
Titanium, per cent	....	....	[a]

[a] Grade T16 shall have a titanium content of not less than four times the carbon content and not more than 0.70 per cent.

Identification Symbol	T21	T22	T7	T9
Grade	Chromium-Molybdenum	Chromium-Molybdenum	7 per cent Chromium	9 per cent Chromium
Carbon, max. per cent	0.15	0.15	0.15	0.15
Manganese, per cent	0.30 to 0.60	0.30 to 0.60	0.30 to 0.60	0.30 to 0.60
Phosphorus, max. per cent	0.04	0.04	0.04	0.04
Sulfur, max., per cent	0.04	0.04	0.04	0.04
Silicon, per cent	0.50 max.	0.50 max.	0.50 to 1.00	0.50 to 1.00
Chromium, per cent	2.75 to 3.25	2.00 to 2.50	6.00 to 7.50	8.00 to 9.50
Molybdenum, per cent	0.80 to 0.95	0.80 to 0.95	0.40 to 0.55	0.80 to 0.95

Table II.—Change the requirements for austenitic steel grades, T8, T18, T19, and T20 to read as follows:

TABLE II.—CHEMICAL REQUIREMENTS OF AUSTENITIC STEEL

Identification Symbol	T8	T18	T19	T20
Grade	Chromium-Nickel	Chromium-Nickel-Titanium	Chromium-Nickel-Columbium	Chromium-Nickel-Molybdenum
Carbon, max., per cent	0.08	0.10	0.10	0.10
Manganese, max., per cent	2.00	2.00	2.00	2.100
Phosphorus, max., per cent	0.04	0.04	0.04	0.04
Sulfur, max., per cent	0.04	0.04	0.04	0.04
Silicon, max., per cent	1.00	1.00	1.00	1.00
Nickel, per cent	8.00 to 10.00	8.00 to 12.00	8.00 to 12.00	10.00 to 14.00
Chromium, per cent	18.00 to 20.00	17.00 to 19.00	17.00 to 19.00	16.00 to 18.00
Molybdenum, per cent	....	....	....	1.75 to 2.50
Titanium, per cent	....	[a]	....	....
Columbium, per cent	....	....	[b]	....

[a] Grade T18 shall have a titanium content of not less than four times the carbon content and not more than 0.60 per cent.

[b] Grade T 19 shall have a columbium content of not less than eight times the carbon content and not more than 1.00 per cent.

Section 9 (c).—Change to read as follows:

(*c*) The tubes shall have a hardness number not to exceed the following:

Grade	Brinell Hardness Number	Rockwell Hardness Number
T5, T11, T16, T21, T22	163	B85
TE7, TE9	179	B89
T8, T18, T19, T20	190	B90

EA – A 249a

Issued, August 28, 1944

The following Emergency Alternate Provisions, when specified, may be used as alternates in A.S.T.M. Standard Specifications for Atomic-Hydrogen-Arc-Welded and Electric-Resistance-Welded Alloy-Steel Boiler and Superheater Tubes (A 249 – 42) and affect only the requirements referred to.

Table I.—Change the requirements for grades T 18, T 19, and T 24 to read as follows:

	Grade T18	Grade T19	Grade T24
Carbon, max., per cent.........	0.10	0.10	0.10
Manganese, max., per cent.....	2.50	2.50	2.00
Phosphorus, max., per cent....	0.04	0.04	0.04
Sulfur, max., per cent..........	0.04	0.04	0.04
Silicon, max., per cent.........	0.75	0.75	1.00
Nickel, per cent...............	9.00	9.50	10.00 to 14.00
Chromium, per cent...........	17.00	17.00	17.50 to 20.00
Molybdenum, per cent.........	...	...	3.00 to 4.00
Titanium, per cent............	[a]	...	...
Columbium, per cent..........	...	[b]	...

EA – A 70b

Issued August 28, 1944

(Superseding Issue of November 17, 1943)

The following Emergency Alternate Provisions, when specified, may be used as an alternate in A.S.T.M. Standard Specifications for Carbon-Steel Plates for Stationary Boilers and Other Pressure Vessels (A 70 – 44) and affect only the requirements referred to:

Section 4.—In the table of chemical composition requirements, change the sulfur content for firebox quality plate from "0.04" to read "0.045," max., per cent.

Section 7.—In the table of tensile properties change the requirement for tensile strength of both flange quality and firebox quality plates from "55,000 to 65,000" to read "55,000 to 70,000" psi.

EA – A 274

Issued, August 28, 1944

Alloy-Steel Blooms, Billets and Slabs for Forgings (A 274 – 44 T)

This provision sets up as alternate grades all of the so-called N.E. steels lists of which have been published by the American Iron and Steel Institute, and by other organizations, and in numerous journals.

EA – B 22a, EA – B 61a, EA – B 62a, EA – B 143b, EA – B 144b, EA – B 145b, EA – B 146b

Issued, August 28, 1944

(Superseding Issue of December 27, 1943)

Bronze Castings for Turntables and Movable Bridges and for Bearing and Expansion Plates of Fixed Bridges (B 22 – 44 T.

Steam or Valve Bronze Castings (B 61 – 44)

Composition Brass or Ounce Metal Castings (B 62 – 44)

Tin-Bronze and Leaded Tin-Bronze Sand Castings (B 143 – 44 T)

High-Leaded Tin-Bronze Sand Castings (B 144 – 44 T)

Leaded Red Brass and Leaded Semi Red Brass Sand Castings (B 145 – 44 T)

Leaded Yellow Brass Sand Castings for General Purposes (B 146 – 44 T)

These revised Emergency Alternate Provisions incorporate only the material referring to the alternate test coupons, requirements on composition, etc., having either been withdrawn or incorporated in the respective 1944 standards and tentative standards.

EA – D 224b

Issued, August 28, 1944

(Superseding Issue of August 30, 1943)

Asphalt Roofing Surfaced With Powdered Talc or Mica (D 224 – 41 T)

In this provision continue only Section 12 (a) which reads as follows:

Section 12 (a).—Omit the requirements for protective coating on nails prescribed in item (a) of this section.

The remainder of this Emergency Alternate Provision is being incorporated in the Tentative Specifications D 224.

For lists of numerous Emergency Alternate Provisions withdrawn see article in forepart of this Bulletin.

Annual Water Conference

Very full two-day sessions featuring interesting technical papers with large numbers of discussions are scheduled for the Fifth Annual Water Conference of the Engineering Society of Western Pennsylvania being held at the Hotel William Penn, Pittsburgh, October 30 and 31. Many A.S.T.M. members and committee people are participating. A partial list of technical contributions follows. Those in charge have been developing an extensive list of discussers who will present prepared material on each of the papers.

Monday, October 30, 1944

Morning—Two Zone Methods for Operating Hydrogen Exchangers for Boiler Feed Water Operation; Recent Experiences in Demineralizing Water. *Afternoon*—Removal of Ammonia by Chlorination; Once Through and Recirculating Cooling Water Studies; Cathodic Protection of Steel Equipment Submerged in Water.

Tuesday, October 31, 1944

Morning—Water Treatment at Koppers United Company Plant; Water Treating Problems in Steel Mills; Water in the Paper Industry. *Afternoon*—Lime and Limestone in Waste Pickle Liquor Treatment; Ozone as a Water Sterilizer; The Use of Silicates for Coagulation.

Offers of Papers for 1945

Committee E-6 on Papers and Publications in anticipation of developing the program for the 1945 Annual Meeting is desirous that members of the Society and others who have in mind submitting offers of technical papers should send these offers to Society Headquarters well in advance of the February meeting of the committee (about Feb. 21). All offers must be accompanied by a summary which should make clear the intended scope of the paper and indicate features that, in the opinion of the author, will justify its inclusion in the annual meeting program. Suitable blanks to be used in transmitting the necessary information will be sent promptly on request.

There are certain points which might well be kept in mind in connection with this matter—first, that the committee in charge does not judge the contribution on the basis of length or comprehensiveness of the paper. A review of A.S.T.M. *Proceedings* will indicate that a very large number of pertinent and important contributions are short or relatively so, although of course there are numerous items that are extensive. Another point is this—with the ASTM Bulletin available for publication of papers there need be no delay in publishing and disseminating items that would lose some of their value if publication were in the *Proceedings* which usually comes out at the end of the year.

New Members to September 18, 1944

The following 86 members were elected from July 17 to September 18, 1944:

Note.—Company memberships are listed first under the respective districts, followed by individual and other members.

Chicago District

Trent Tube Manufacturing Co., Torris Torrison, Superintendent, East Troy, Wis.

Union Special Machine Co., F. L. Robbins, Chief Inspector, 400 N. Franklin St., Chicago 10, Ill.

Ellmore, W. Austin, Vice-President, Utah Radio Products Co., 320 W. Ohio St., Chicago 10, Ill.

Moon, J. Milton, Chief Research Engineer, Signode Steel Strapping Co., 2600 N. Western Ave., Chicago 47, Ill.

Morris, Russel A., Engineer, Anaconda Wire and Cable Co., Sycamore, Ill. For mail: Somonauk and Elm Sts., Sycamore, Ill.

Prosser, Robert A., Chief Engineer, Illinois Clay Products Co., 608 S. Dearborn St., Chicago 5, Ill.

Cleveland District

Glidden Co., The, Chemical and Pigment Co. Divisions, C. P. Engelsman, Executive Assistant, 1396 Union Commerce Bldg., Cleveland 14, Ohio.

Turnbull, Inc., J. Gordon, J. Gordon Turnbull, President, 2630 Chester Ave., Cleveland 14, Ohio.

Bowen, Milton M., Vice-President, General Paint Corp., 3091 Mayfield Rd., Cleveland 18, Ohio.

Eisenman, W. H., Secretary, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

Detroit District

Calingaert, George, Director of Chemical Research, Ethyl Corp., 1600 W. Eight Mile Rd., Detroit 20, Mich.

Foltz, Norman L., Chemist, Parker Rust-Proof Co., 2177 E. Milwaukee Ave., Detroit 11, Mich.

Levinson, Irving J., Metallurgical Foreman, Buick Motor Division, General Motors Corp., Flint, Mich. For mail: 218 E. Kearsley, Flint 2, Mich. [J]*

Liddicoat, R. T., Assistant Professor of Engineering Mechanics, Engineering College, University of Michigan, Ann Arbor, Mich. For mail: 1602 Morton Ave., Ann Arbor, Mich.

Mansfield, George A., Technical Service Director, Huron Portland Cement Co., Thirteenth Floor, Ford Bldg., 601 Griswold St., Detroit 26, Mich.

Reese, Raymond C., Consulting Engineer, Box 58, Toledo 1, Ohio.

Sheehan, Thomas H., Chief Inspector, F. L. Jacobs Co., Detroit, Mich. For mail: 16205 Washburn, Detroit 21, Mich.

New York District

Airequipt Manufacturing Co., Inc., William J. Tyrrell, President, 339 N. High St., Mount Vernon, N. Y.

Boonton Radio Corp., 518 Main St., Boonton, N. J.

Du Mont Laboratories, Inc., Allen B., Estle Ray Mann, Research Engineer, 2 Main Ave., Passaic, N. J.

Givaudan-Delawanna, Inc., A. R. Cade, Chemist and Bacteriologist, Delawanna, N. J.

Lithaloys Corp., H. Osborg, Vice-President, 444 Madison Ave., New York 22, N. Y.

Standard Motor Products, Inc., E. Kameny, Chief Engineer, 37-18 Northern Blvd., Long Island City 1, N. Y.

Ashner, Rudolph M., Partner, Plant Organizing Methods Co., 60 E. Forty-second St., New York 17, N. Y.

Bretz, Sylvester S., Chemist, Walter Kidde and Co., Inc., Belleville, N. J. For mail: 62 Collins Ave., Bloomfield, N. J.

Brooner, Bernice S., American Standards Assn., Grand Central Terminal Office Bldg., 70 E. Forty-fifth St., New York 17, N. Y.

Calkin, John B., Research Assistant to Executive Vice-President, Union Bag and Paper Corp., 233 Broadway, New York 7, N. Y.

Cavanagh, Patrick E., Metallurgist, Allen B. Du Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J.

Doanides, Peter J., Lieutenant, Royal Hellenic Navy, Greek Embassy, Washington, D. C. For mail: Room 1820, 30 Rockefeller Plaza, New York 20, N. Y.

Greenfield, Frank Lynne, President, Frank L. Greenfield Co., Woolworth Bldg., 233 Broadway, New York 7, N. Y.

Luckenbach, J. Lewis, Structural and Mechanical Engineer, Anaconda Copper Mining Co., 25 Broadway, New York, N. Y. For mail: 3245 Seventy-seventh St., Jackson Heights, L. I., N. Y.

Meyers, Frederic R., Chief Engineer, American K.A.T. Corp., New York, N. Y. For mail: 815 E. Fourteenth St., Brooklyn, N. Y.

National Resources Commission of China, Technical Office in U.S.A., L. F. Chen, Representative, 111 Broadway, New York 6, N. Y.

Noel, Don O., Plant Engineer, Metals Disintegrating Co., Inc., Elizabeth B, N. J.

Pearson, Herbert P., Technical Director, Kotal Co., 52 Vanderbilt Ave., New York 17, N. Y.

Rodman, Clarke Alden, Research Fuels and Lubricants Chemist, Mack Manufacturing Corp., Plainfield, N. J. For mail: 137 Crescent Ave., Plainfield, N. J. [J]

Thwaits, E. H., Research Engineer, American Iron and Steel Inst., 350 Fifth Ave., New York 1, N. Y.

Werner, Herbert L., Owner, Werner Textile Consultants, 60 E. Forty-second St., New York 17, N. Y.

Northern California District

Hendy Iron Works, Joshua, C. Donald D'Amico, Plant Metallurgist, Sunnyvale, Calif.

Harrison, W. F., Vice-President, The Adhesive Products, Inc., 430 Main St., San Francisco 5, Calif.

Morse, G. H., Owner, Morse Laboratories, 316 Sixteenth St., Sacramento 14, Calif.

Randall, Merle, Research Director, Stuart Oxygen Co., 2295 San Pablo Ave., Berkeley 2, Calif.

Philadelphia District

Eastern Malleable Iron Co., The, George E. Bean, Managing Director, Wilmington 99, Del.

Eysenbach, Henry A., Jr., Engineer, James G. Biddle Co., Philadelphia, Pa. For mail: 4120 Greeby St., Philadelphia 35, Pa.

Pittsburgh District

Menard, Paul W. K., Chief Metallurgist and Inspector, Carnegie-Illinois Steel Corp., Third and Walnut Sts., McKeesport, Pa.

Moorhead, H. A., Metallurgical Engineer, Carnegie-Illinois Steel Corp., 1465 Frick Annex Bldg., Pittsburgh 30, Pa.

Roche, James N., Manager of Technical Dept., Koppers Co., Tar and Chemical Div., Box 7372, Oakland Station, Pittsburgh 13, Pa.

Thomas, Robert O., Chief Inspector, Homestead Steel Works, Carnegie-Illinois Steel Corp., Munhall, Pa.

von Ende, H. L., Metallurgical Engineer, Carnegie-Illinois Steel Corp., 1204 Carnegie Bldg., Pittsburgh 30, Pa.

Southern California District

Applied Research Laboratories, M. F. Hasler, Director of Research and Development, 4336 San Fernando Rd., Glendale, Calif.

Consolidated Vultee Aircraft Corp., R. A. Miller, Chief Structural Research Engineer, Development Engineering Dept., San Diego 12, Calif.

Douglas Aircraft Co., Inc., Engineering Library, Department A2-250, 1369 Sepulveda Blvd., West Los Angeles, Calif.

Lockheed Aircraft Corp., Hall L. Hibbard, Vice-President and Chief Engineer, Box 551, Burbank, Calif.

North American Aviation, Inc., L. P. Spalding, Chief Research Engineer, 5701 Imperial Highway, Inglewood, Calif.

Crawshaw, Arthur Clyde, Coordinator, Plans and Specifications, Holmes & Narver, 639 S. Spring St., Los Angeles 14, Calif.

Harrison, Raymond Dwight, Assistant Engineer, U. S. Engineer Dept., Lab., Los Angeles, Calif. For mail: 9537 S. Western Ave., Los Angeles 44, Calif.

Lewis, Vincent F., Mechanical Engineer, Development Div., Adel Precision Products Corp., Burbank, Calif. For mail: 1426 N. Myers St., Burbank, Calif.

Nader, H. R. H., Laboratory Analyst, Ryan Aeronautical Co., 2159 State St., San Diego, Calif.

Smith, Kenneth A., Instructor of X-ray, Physics Dept., University of Southern California, Los Angeles, Calif.; and Project Engineer, Gille Bros., Los Angeles, Calif. For mail: 231 N. Lima St., Burbank, Calif.

Western New York-Ontario District

Robinson (Canada), Ltd., E. S. & A., Alan Woodcock, Head of Research Div., Laird and Esandar Drs., Lesaide, Toronto, Ont., Canada.

Morris, L. D., Curtiss-Wright Corp., Airplane Div., Research Lab., Buffalo 5, N. Y.

SMITH, RANDALL C., Materials Engineer, Curtiss-Wright Corp., 81 Grosvenor Rd., Kenmore 17, N. Y.

U. S. and Possessions

OTHER THAN A.S.T.M. DISTRICTS

HICKS ENGINEERING CO., INC., S. D., John S. Raleigh, Chief Engineer, 1671 Hyde Park Ave., Hyde Park 36, Mass.

RAYTHEON MANUFACTURING CO., Mrs. H. C. Hennig, Librarian, Building G, Foundry Ave., Waltham 54, Mass.

PEPPERELL MANUFACTURING CO., H. D. Evans, Chemist, Biddeford, Me.

WEYERHAEUSER TIMBER CO., C. C. Heritage, Technical Director, Longview, Wash. [S]†

COOLEDGE, HAROLD N., JR., Vice-President, F. J. Cooledge and Sons, Box 1940, Atlanta 1, Ga.

CURTIN, T. I., JR., Vice-President, Waltham Foundry Co., 71 Felton St., Waltham, Mass.

DUCKERING, WILLIAM ELMHIRST, Dean of Faculty, University of Alaska, College, Alaska.

GOLDBLATT, LEO A., Chemist, Naval Stores Research Div., Southern Regional Research Lab., U. S. Department of Agriculture, 2100 Robert E. Lee Blvd., New Orleans 19, La.

HERMES, RAYMOND FRANCIS, Chief Engineer, Aeronca Aircraft Corp., Middletown, Ohio.

HOFFMAN, MANFRED T., Technical Director, Merrimac Hat Corp., Amesbury, Mass.

HORNIBROOK, F. B., Materials Engineer, National Bureau of Standards, Washington 25, D. C.

McQUILLIN, LORIS E., Chemist, Dewey Portland Cement Co., Dewey, Okla.

MORGAN, DON, Industrial Engineer, Westinghouse Electric and Manufacturing Co., X-Ray Division, 2519 Wilkins Ave., Baltimore 3, Md.

MYERS, HAROLD N., Chief Metallurgist, Sealed Power Corp., 500 Sanford St., Muskegon, Mich.

PHILIPS, OLIN HIGBEE, Metallurgical Engineer, American Car and Foundry Co., Berwick 6, Pa.

REDUS, JOHN FRANKLIN, Assistant Engineer, U. S. Waterways Experiment Station, War Dept., U. S. Engineers, Box 631, Vicksburg, Miss.

RICHARDS, EMORY A., Technical Sales, Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J. For mail: Box 555, Harrisville, R. I.

SANDHOLZER, MARJORIE W., Assistant Chemist, National Bureau of Standards, 264 Industrial Bldg., Washington 25, D. C.

SODERBERG, KARL GUSTAF, Head Industrial Specialist, Conservation Div., War Production Board, Washington, D. C. For mail: 412 Turner St., Chevy Chase 15, Md.

Other than U. S. and Its Possessions

COMMONWEALTH INDUSTRIAL GASES, LTD., THE, J. F. Clack, Managing Director, 138 Bourke Rd., Alexandria, N. S. W., Australia.

OLYMPIC TYRE AND RUBBER CO., LTD., THE, C. S. Grainger, Factory Manager and Chief Engineer, Box 52, Footscray, W. 11, Victoria, Australia.

LAMARCHE, C. E., Technical Information Engineer, Quebec Provincial Department of Roads, Parliament Bldgs., Quebec, P. Q., Canada.

SHAW, W. S., Porritts & Spencer, Ltd., Research Dept., Bamford Woollen Mills, Nr. Rochdale, Lancashire, England.

YOUNG, EDGAR, Works Manager, N. Hingley and Sons, Ltd., Dudley, England.

* [J]—Denotes Junior Member.
† [S]—Denotes Sustaining Member.

Personals

• • • News items concerning the activities of our members will be welcomed for inclusion in this column.

BERNARD B. BETTY, formerly Research Engineer, The International Nickel Co., Inc., Huntington, W. Va., is now Partner, Betty Machine Co., Nashville, Tenn.

GEORGE P. NELSON is connected with L. A. Young Spring and Wire Corp., Detroit, Mich., as Director of Engineering. He was formerly Factory Manager, Precision Spring Corp., Detroit.

FREDERIC THEODORE MAVIS is now Professor of Civil Engineering and Head, Department of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa. He was Professor and Head, Department of Civil Engineering, and Acting Head, Department of Engineering Mechanics, The Pennsylvania State College, State College, Pa.

LOUIS ALBERT WEINLAND, formerly Director of Research, Simonds Worden White Co., Dayton, Ohio, is now Research Associate, Ohio State University Research Foundation, Columbus, Ohio.

At the 190th Commencement at Columbia University in June the following two men concerned with Society affairs were honored: Lyman J. Briggs, Director, National Bureau of Standards, received the Doctor of Science Degree; and JAMES T. KEMP, Conservation Representative of the U. S. Mission for Economic Affairs, stationed in England, received a University Medal.

WILLIAM EUGENE CAMPBELL, formerly Materials Engineer, Pollock-Stock Shipbuilding Co., Stockton, Calif., is now in the Road Design Department, Indiana State Highway Commission, New Castle, Ind.

DONALD WOOD is now Research and Methods Engineer, National Silver Co., Brooklyn, N. Y. He was Research Engineer, R. Wallace and Sons Manufacturing Co., Wallingford, Conn.

L. S. REID, formerly Senior Technician, Standardization Laboratory, Metropolitan Life Insurance Co., New York, N. Y., has been appointed to Assistant to Second Vice-President of the company.

PAUL V. GARIN has been appointed Engineer of Tests, Southern Pacific Co., San Francisco, Calif. Mr. Garin is the new secretary of the Northern California District Committee.

ARTHUR PHILLIPS, Professor of Metallurgy, Hammond Laboratory, Yale University, New Haven, Conn., who has been teaching metallurgy at the University of São Paulo for the past few months, arrived in Miami in July from Brazil, and is now back at Yale.

J. A. KIES, who was Associate Metallurgist, National Bureau of Standards, Washington, D. C., is now Engineering Physicist—Materials, Western Regional Research Laboratory, U. S. Department of Agriculture, Albany, Calif.

L. B. HUTCHINSON is now Assistant Chief Engineer, Design Department, Elco Naval Division, Electric Boat Co., Bayonne, N. J. He was Chief of Laboratories, Brewster Aeronautical Corp., Hatboro, Pa.

WILLIAM V. BAUER, formerly Chemical Engineer, Foster Wheeler Corp., Carteret Laboratory, Carteret, N. J., is now Chemical Engineer, Hydrocarbon Research, Inc., New York, N. Y.

R. B. HARPER, Vice-President, Peoples Gas, Light and Coke Co., Chicago, Ill., was honored by the Chicago Chapter of the American Institute of Chemists at the Chapter's annual testimonial dinner on October 6. Dr. Harper was selected not only for his outstanding work on the chemisty and technology of combustible gases, but also for his vital interest in promoting the chemist and the chemical profession.

RICHARD E. METZGER, formerly Chemist, Pittsburgh Testing Laboratory, Pittsburgh, Pa., is now Research Chemist, The General Tire and Rubber Co., Akron, Ohio.

JOSEPH ZAPATA is now Asphalt Technologist, U. S. Gypsum Co., Chicago, Ill. He was Assistant Materials Engineer, Laboratory, State Highway Commission of Wisconsin, Madison, Wis.

GERSHON L. OLIENSIS, who was Chemist in Charge, Barber Asphalt Corp., Madison, Ill., is now Director of Research, Babbitt-Barber Asphalt Products, Inc., Madison, Ill.

C. E. SKINNER who had retired as Assistant Director of Engineering, Westinghouse Electric and Manufacturing Co., is now Senior Electrical Engineer, Fort Monmouth Signal Laboratory, Riverside Heights, Red Bank, N. J.

ALFRED SUGAR, formerly in the Aluminum Division, U. S. Metals

Refining Co., Carteret, N. J., is now connected with The American Metal Co., Ltd., New York, N. Y.

C. Y. THOMAS is now General Manager, The Military Chemical Works, Inc., Pittsburg, Kans. He was Chief Engineer, Pittsburg and Midway Coal Mining Co., Pittsburg, Kans.

PERCY H. WALKER, who was Associate Chemist, Bureau of Ships, U. S. Navy, Navy Department, Washington, D. C., is now Associate Chemist, National Bureau of Standards, Washington, D. C.

ROBERT F. MEHL, Director, Metals Research Laboratory, and Head, Department of Metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa., who returned to the States in May from Brazil where he lectured at the Escola Politecnica of the University of São Paulo, has been awarded the honorary degree of *doctor honoris causa* by the Escola Politecnica.

WALLACE E. WING has been elected President of the Marblehead Lime Co., Chicago, Ill. He was formerly Vice-President of the company.

THOMAS McLEAN JASPER, formerly Director of Research, A. O. Smith Corp., Milwaukee, Wis., is now Technical and Research Director, General American Transportation Corp., Chicago, Ill. Mr. Jasper's work will be to assist and collaborate with the engineering, production and sales groups of the corporation.

Two A.S.T.M. members have been elected officers of the American Society for Metals, as follows: *President*: KENT R. VAN HORN, Research Metallurgist, Metal Division, Aluminum Research Laboratories, Aluminum Company of America, Cleveland, Ohio; and *Trustee:* LEWIS S. BERGEN, Associate Director of Metallurgy and Research, Crucible Steel Co. of America, New York, N. Y.

In the design of the new laboratory building of Jessop Steel Co. at Washington, Pa., R. F. MEHL, Director, Metals Research Laboratory, and Head, Department of Metallurgy, Carnegie Institute of Technology, Pittsburgh, and Metallurgical Consultant of Jessop, and R. E. MALMBERG, Chief Metallurgist, Jessop Steel Co., cooperated with Robert K. Kulp, Director of Research for the company. The building is designed to facilitate the development of new alloy steels and testing of metals.

N. L. MOCHEL, Manager, Metallurgical Engineering, Westinghouse Electric and Manufacturing Co., Philadelphia, Pa., was the speaker at the opening meeting of the Philadelphia Chapter of the American Society for Metals held at Temple University, Friday, September 29. Mr. Mochel spoke on "Some Wartime Metallurgical Developments and Their Possible Place in the Post-War Period."

FRANK G. STEINEBACH, Editor, *The Foundry*, who is active in A.S.T.M. technical work and a member of the Cleveland District Committee, was honored at the annual meeting of the Penton Publishing Co. early this year by election as Vice-President and Secretary of the company. This information, while somewhat belated, will nevertheless be of interest to many of the members.

Two A.S.T.M. members were among the newly elected officers of the American Welding Society, as follows: *President:* A. C. WEIGEL, President, Combustion Engineering Co., New York, N. Y., and *Treasurer:* O. B. J. FRASER, Director Technical Service on Mill Products, International Nickel Co., New York, N. Y.

DAVID LARKIN, Vice-President and General Manager, Broderick & Bascom Rope Co., St. Louis, Mo., was elected Vice-President of The American Society of Mechanical Engineers and will assume the duties of his new position at the annual meeting of the A.S.M.E. in New York in November.

WALTER J. BEICHERT, formerly connected with Lindsay Laboratories, Brooklyn, N. Y., is now Chemist, Polytechnique Laboratories, Ozone Park, N. Y.

CURTIS CANTRILL has returned to the Kentucky State Highway Department as Principal Highway Engineer of Highway Materials Research Laboratory, Lexington, Ky. For a while he was Assistant Chief, Flexible Pavement Branch, U. S. Waterways Experiment Station, Vicksburg, Miss.

E. M. SCHRODER is relinquishing his position as Chief Chemist of Australian Cement, Ltd., Geelong, Victoria, Australia, to accept a position with Adelaide Cement Co., Ltd., Adelaide, South Australia.

J. A. KIRKPATRICK, formerly Chief Inspector, Tubular Alloy Steel Corp., Gary, Ind., is now Vice-President and General Manager, Universal Fittings and Scaffolding Co., Zelienople, Pa.

LADISLAV BOOR is now connected with the American Instrument Co., Silver Spring, Md. He was with the Physics Division, American Cyanamid Co., Stamford Laboratories, Stamford, Conn.

It was very interesting to read in the *Saturday Evening Post* of August 12 in the article "Advertising Paid Off at Cherbourg" about the part played by Alexis Sommaripa, former member of the Society who was active in the work of Committee D-13 on Textile Materials. This article is the story of an Allied sound-truck crew which within 26 hours "sold" hundreds of enemy soldiers on the "luxurious" delights of surrendering, thus conserving our own forces. Mr. Sommaripa, formerly with du Pont, is an expert in European affairs, and as a civilian aided greatly in this interesting invasion operation that was carried out by the press-and-psychological-warfare section of the 1st Army.

LOUIS KRISTOFF, formerly Chief Metallurgist, National Aluminum Cylinder Head Co., Cleveland, Ohio, is now Foundry Metallurgist, Reynolds Metals Co., Springfield, Mass.

M. E. GREENHOW is now connected with Olds Alloys Co., South Gate, Calif., as Vice-President. He was formerly Assistant Manager, Berg Metals Corp., Los Angeles, Calif.

At the eightieth convention of the Electrochemical Society in Buffalo WILLIAM BLUM, Chemist, National Bureau of Standards, Washington, D. C., received the Acheson Gold Medal and one thousand dollar prize in recognition of his outstanding services in the standardization of the electroplating art.

FRED GROTTS, President, Fort Pitt Steel Casting Co., McKeesport, Pa., a subsidiary of H. K. Porter Co., Inc., Pittsburgh, Pa., has been appointed to a newly created position, in addition to his present one, as director of research and metallurgy for all Porter plants. He will have charge of problems relating to materials and metallurgy and will direct new product developments.

VAN M. DARSEY, formerly Technical Director, Parker Rust Proof Co., Detroit, Mich., has been elected President and a member of the Board of Directors.

Electrolytic Solutions

"The Physical Chemistry of Electrolytic Solutions" by Herbert S. Harned, Professor of Chemistry, Yale University, and Benton B. Owen, Associate Professor of Chemistry, Yale University, is a recent addition to the American Chemical Society Series of Scientific and Technologic Monographs. The purpose of this publication is an authoritative, coordinated presentation in concise, readable form, of available knowledge on the chosen subject. The book is divided into three general parts: (1) theory, (2) experimental methods, and (3) properties of electrolytes, giving an intensive and complete coverage of the physical chemistry of electrolytes. A complete glossary of symbols and an extensive appendix of tables derived from the best available data are included. This 611-page publication is available in cloth binding from the Reinhold Publishing Corp., 330 W. 42nd Street, New York, N. Y., at $10 per copy.

Textile Research

An interesting booklet entitled "A New Opportunity for All Textile Men Through Research" has been issued by the Textile Research Institute, 10 East 40th St., New York 16, N. Y. This describes the need for an over-all research organization, covers the various organizations functioning in the field, and describes the new Textile Research Institute with details on membership.

Complete List of A.S.T.M. Emergency Specifications and Emergency Alternate Provisions as of October 16

Emergency Specifications for

ES–1a *Discontinued*—Replaced by B 189–44 T.
ES–2 *Discontinued*—Replaced by A 267–44 T.
ES–3 *Discontinued*—Replaced by B 117–44 T.
ES–4 *Discontinued*—Replaced by E 33–42.
ES–5a Carbon-Chromium Ball and Roller-Bearing Steels.
ES–6a GR-S Synthetic Rubber Sheath Compound for Electrical Insulated Cords and Cables Where Extreme Abrasion Resistance Is Not Required.
ES–7 Fire-Refined Copper for Wrought Products and Alloys.
ES–8 *Discontinued*—Replaced by C 193–44 T.
ES–9 *Discontinued*—Replaced by C 194–44 T.
ES–10 *Discontinued*—Replaced by C 195–44 T.
ES–11 *Discontinued*—Replaced by C 196–44 T.
ES–12 *Discontinued*—Replaced by C 197–44 T.
ES–13 *Discontinued*—Replaced by C 197–44 T.
ES–14 Blanket Thermal Insulation for Building Purposes.
ES–15 Blanket Thermal Insulation for Industrial Purposes.
ES–16 Blanket Thermal Insulation for Refrigeration.
ES–17 Preformed Pipe Covering Thermal Insulation.
ES–18 Preformed Block Thermal Insulation.
ES–19 Structural Board Thermal Insulation.
ES–20 *Discontinued*—Replaced by A 277–44 T.
ES–21 Carbon-Steel and Alloy-Steel Forgings for Magnetic Retaining Rings for Turbine Generators.
ES–22 Alloy-Steel Forgings for Nonmagnetic Coil Retaining Rings for Turbine Generators.
ES–23 Carbon-Steel Forgings for Rings for Main Reduction Gears.
ES–24 Carbon-Steel and Alloy-Steel Forgings for Pinions for Main Reduction Gears.
ES–25 Carbon-Steel and Alloy-Steel Forgings for Turbine Generator Rotors and Shafts.
ES–26 Carbon-Steel and Alloy-Steel Forgings for Turbine Rotors and Shafts.
ES–27 Carbon-Steel and Alloy-Steel Forgings for Turbine Bucket Wheels.
ES–28 *Discontinued*—Replaced by D 752–43 T.
ES–29 Special Quality Aluminum Die Castings.
ES–30 *Discontinued*—Replaced by D 753–43 T.
ES–31 Electrodeposited Coatings of Lead on Steel.
ES–32 Method of Test for Color of U. S. Army Motor Fuel (All-Purpose) by Means of an A.S.T.M. Color Standard.
ES–33 *Discontinued*—Replaced by D 754–43 T.
ES–34 *Discontinued*—Replaced by D 755–43 T.
ES–35 Method of Test for Changes in Protective Properties of Organic Coatings on Steel Surfaces When Subjected to Immersion.
ES–36 *Discontinued*—Replaced by D 808–44 T.
ES–37 *Discontinued*—Replaced by D 809–44 T.
ES–38 *Discontinued*—Replaced by D 810–44 T.
ES–39 *Discontinued*—Replaced by D 811–44 T.
ES–40 Special Quality, Magnesium-Base Alloy Die Castings.
ES–41 Communication and Signal Pin-Type Lime-Glass Insulators.
ES–42 Method for Determination of Isopentane and Benzene Insolubles in Used Lubricating Oils.

Emergency Alternate Provisions in Specifications for

Steel

EA–A 1 Open-Hearth Carbon-Steel Rails (A 1–39).
EA–A 21 Carbon-Steel Axles for Cars and Tenders (A 21–36).
EA–A 25a Wrought Steel Wheels for Electric Railway Service (A 25–41).
EA–A 26 Steel Tires (A 26–39).
EA–A 27 Carbon-Steel Castings for Miscellaneous Industrial Uses (A 27–44).
EA–A 53 Welded and Seamless Steel Pipe (A 53–44).
EA–A 57 Multiple-Wear Wrought Steel Wheels (A 57–44).
EA–A 70b Carbon-Steel Plates for Stationary Boilers and Other Pressure Vessels (A 70–44).
EA–A 83 Lap-Welded and Seamless Steel and Lap-Welded Iron Boiler Tubes (A 83–44).
EA–A 87 Carbon-Steel and Alloy-Steel Castings for Railroads (A 87–44).
EA–A 89 Low-Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (A 89–43).
EA–A 95 Carbon-Steel Castings for Valves, Flanges, and Fittings for High-Temperature Service (A 95–44).
EA–A 120 Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses (A 120–44).
EA–A 134 Electric-Fusion-Welded Steel Pipe (Sizes 30 in. and Over) (A 134–42).
EA–A 135 Electric-Resistance-Welded Steel Pipe (A 135–44).
EA–A 139a Electric-Fusion-Welded Steel Pipe (Sizes 8 in. to but not Including 30 in.) (A 139–42).
EA–A 148a Alloy-Steel Castings for Structural Purposes (A 148–44).
EA–A 157a Alloy-Steel Castings for Valves, Flanges, and Fittings for Service at Temperatures from 750 to 1100 F. (A 157–44).
EA–A 158 Seamless Alloy-Steel Pipe for Service at Temperatures from 750 to 1100 F. (A 158–44 T).
EA–A 160 Axle-Steel Bars for Concrete Reinforcement (A 160–39).
EA–A 161 Seamless Low-Carbon and Carbon-Molybdenum Steel Still Tubes for Refinery Service (A 161–44).
EA–A 167a Corrosion-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip (A 167–44).
EA–A 177 High-Strength Corrosion-Resisting Chromium-Nickel Steel Sheet and Strip (A 177–44).
EA–A 178 Electric-Resistance-Welded Steel and Open-Hearth Iron Boiler Tubes (A 178–44).
EA–A 179 Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes (A 179–44).
EA–A 183 Heat-Treated Carbon- and Alloy-Steel Track Bolts and Nuts (A 183–40 T).
EA–A 186 One-Wear and Two-Wear Wrought Steel Wheels (A 186–39).
EA–A 192 Seamless Steel Boiler Tubes for High-Pressure Service (A 192–44).
EA–A 194 Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service to 1100 F. (A 194–40).
EA–A 199 Seamless Cold-Drawn Intermediate Alloy-Steel Heat-Exchanger and Condenser Tubes (A 199–44).
EA–A 200 Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service (A 200–44).
EA–A 206 Seamless Carbon-Molybdenum Alloy-Steel Pipe for Service at Temperatures from 750 to 1000 F. (A 206–44 T).
EA–A 209 Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes (A 209–44).
EA–A 211 Spiral-Welded Steel or Iron Pipe (A 211–44).
EA–A 213a Seamless Alloy-Steel Boiler and Superheater Tubes (A 213–44).
EA–A 214a Electric-Resistance-Welded Steel Heat-Exchanger and Condenser Tubes (A 214–44).
EA–A 215 Carbon-Steel Castings Suitable for Fusion Welding for Miscellaneous Industrial Uses (A 215–44).
EA–A 216a Carbon-Steel Castings Suitable for Fusion Welding for Service up to 850 F. (A 216–44 T).
EA–A 217 Alloy-Steel Castings Suitable for Fusion Welding for Service from 750 to 1100 F. (A 217–44 T).
EA–A 226 Electric-Resistance-Welded Steel Boiler and Superheater Tubes for High-Pressure Service (A 226–44).
EA–A 235 Carbon-Steel Forgings for General Industrial Use (A 235–42).
EA–A 236a Carbon-Steel Forgings for Locomotives and Cars (A 236–42).
EA–A 237 Alloy-Steel Forgings for General Industrial Use (A 237–42).
EA–A 238 Alloy-Steel Forgings for Locomotives and Cars (A 238–42).
EA–A 240a Corrosion-Resisting, Chromium and Chromium-Nickel Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels (A 240–44).
EA–A 244 Heat-Treated Wrought Steel Wheels (A 244–44).
EA–A 249a Atomic-Hydrogen-Arc-Welded and Electric-Resistance-Welded Alloy-Steel Boiler and Superheater Tubes (A 249–44).
EA–A 250 Electric-Resistance-Welded Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes (A 250–44 T).
EA–A 268 Seamless and Welded Ferritic Stainless Steel Tubing for General Service (A 268–44 T).
EA–A 269 Seamless and Welded Austenitic Stainless Steel Tubing for General Service (A 269–44 T).
EA–A 270 Seamless and Welded Austenitic Stainless Steel Tubing for the Dairy and Food Industry (A 270–44 T).
EA–A 271 Seamless Austenitic Chromium-Nickel Steel Still Tubes for Refinery Service (A 271–44 T).
EA–A 274 Alloy-Steel Blooms, Billets, and Slabs for Forgings (A 274–44 T).

Non-Ferrous Metals and Alloys

EA-B 12 Copper Bars for Locomotive Staybolts (B 12-42).
EA-B 16 Free-Cutting Brass Rod for Use in Screw Machines (B 16-44)
EA-B 22b Bronze Castings for Turntables and Movable Bridges and for Bearing and Expansion Plates of Fixed Bridges (B 22-44 T).
EA-B 23b White Metal Bearing Alloys (Known Commercially as "Babbitt Metal") (B 23-26).
EA-B 32a Soft Solder Metal (B 32-40 T).
EA-B 61a Steam or Valve Bronze Castings (B 61-44).
EA-B 62a Composition Brass or Ounce Metal Castings (B 62-44).
EA-B 111 Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock (B 111-43).
EA-B 122 Copper-Nickel-Zinc and Copper-Nickel Alloy Sheet and Strip (B 122-42).
EA-B 135 Miscellaneous Brass Tubes (B 135-43 T).
EA-B 143b Tin-Bronze and Leaded Tin-Bronze Sand Castings (B 143-44 T).
EA-B 144b High-Leaded Tin-Bronze Sand Castings (B 144-44 T).
EA-B 145b Leaded Red Brass and Leaded Semi Red Brass Sand Castings (B 145-44 T).
EA-B 146b Leaded Yellow Brass Sand Castings for General Purposes (B 146-44 T).
EA-B 148a Aluminum-Bronze Sand Castings (B 148-44 T).
EA-B 171 Copper-Alloy Condenser Tube Plates (B 171-42 T).

"C" and "D" Groups

EA-C 150 Portland Cement (C 150-42).
EA-D 27a Insulated Wire and Cable: Class AO, 30 per cent Hevea Rubber Compound (D 27-41).
EA-D 69a Friction Tape for General Use for Electrical Purposes (D 69-38).
EA-D 97 Test for Cloud and Pour Points (D 97-39).
EA-D 119 Rubber Insulating Tape (D 119-38).
EA-D 129 Test for Sulfur in Petroleum Oils by Bomb Method (D 129-44).
EA-D 147 Methods of Testing Bituminous Mastics, Grouts, and Like Mixtures (D 147-41).
EA-D 224b Asphalt Roofing Surfaced with Powdered Talc or Mica (D 224-44 T).
EA-D 231 Testing and Tolerances for Knit Goods (D 231-39).
EA-D 249b Asphalt Roofing Surfaced with Coarse Mineral Granules (D 249-44 T).
EA-D 353 Insulated Wire and Cable: Performance Rubber Compound (D 353-41).
EA-D 375 Test for Asbestos Roving for Electrical Purposes (D 375-44). (Specifications and Methods).
EA-D 455 Milled Toilet Soap (D 455-39).
EA-D 469a Insulated Wire and Cable: Heat-Resisting Rubber Compound (D 469-41).
EA-D 496a Chip Soap (D 496-39).
EA-D 498a Powdered Soap (Nonalkaline Soap Powder) (D 498-39).
EA-D 499 White Floating Toilet Soap (D 499-39).
EA-D 524 Test for Carbon Residue of Petroleum Products (Ramsbottom Carbon Residue) (D 524-42).
EA-D 532a Rubber Sheath Compound for Electrical Insulated Cords and Cables (D 532-39 T).
EA-D 535 Palm Oil Solid Soap (Type A, Pure; Type B, Blended) (D 535-41).
EA-D 536 Palm Oil Chip Soap (Type A, Pure; Type B, Blended) (D 536-42).
EA-D 574a Insulated Wire and Cable: Ozone-Resistant Type Insulation (D 574-40 T).
EA-D 592 Olive Oil Solid Soap (Type A, Pure; Type B, Blended) (D 592-42).
EA-D 593 Salt-Water Soap (D 593-42).
EA-D 607 Mica Pigment (D 607-42).
EA-D 630 Olive Oil Chip Soap (Type A, Pure; Type B, Blended) (D 630-42).

Catalogs and Literature Received

LEEDS & NORTHRUP CO., 4943 Stenton Ave., Philadelphia 44, Pa. Catalog N-33B, a 48-page publication entitled "Micromax and Speedomax Rayotube Pyrometers"—a revised edition of the 1941 publication. Covers for the first time equipment being used to measure the temperature of molten cast iron, electric salt pots, and blast furnace stove domes.

Also, Catalog EN-95, "Apparatus for Electrolytic Conductivity Measurements in Laboratory and Plant," 44 pages. This revised publication presents much the same data about methods of measurements and notes for selection and use of the apparatus as did the previous edition, but in addition, it illustrates and describes a Signalling Conductivity Controller and several new industrial cells which have become available since the earlier edition was issued. Illustrated.

Catalog N-33D, a 16-page catalog entitled "Optical Pyrometer" recently reprinted with minor changes. Describes the potentiometer-type instrument. Illustrated.

Catalog E-33A(1), revised edition of a 12-page catalog entitled "Wenner Thermocouple Potentiometer." Describes the basic advantages which this potentiometer makes available. There is discussion of the Wenner principle underlying the instrument design and the chief characteristics and advantages of this instrument.

GEORGE SCHERR CO., INC., 200 Lafayette St., New York 12, N. Y., has resumed, with its current issue No. 105, regular publication of its well-known house organ "Precision Production." This issue covers Opti-Flats, the new glass surface plate, polished by optical methods. Also, a four-page folder describing the Scherr Opti-Flat, a new glass optically finished surface plate which is guaranteed flat to 0.00005 in.

PICKER X-RAY CORP., 300 Fourth Ave., New York, N. Y. Bulletin 1444, illustrating and describing the new 50-kv. Industrial X-ray Unit for low kilovoltage X-ray inspection. Four pages, illustrated.

W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa. A 44-page catalog entitled "Apparatus and Chemicals for Water Analyses," including descriptions and illustrations of apparatus and chemicals necessary for the more common water analyses. The catalog is divided into three sections—Laboratory Services, Test Sets—Single Determination, and Test Sets—Combination.

TINIUS OLSEN TESTING MACHINE CO., 550 N. Twelfth St., Philadelphia 23, Pa. Bulletin 29, a four-page folder entitled "L-Type Hydraulic Testing Machines." Illustrated.

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